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2922

SKF

BALL AND ROLLER BEARINGS

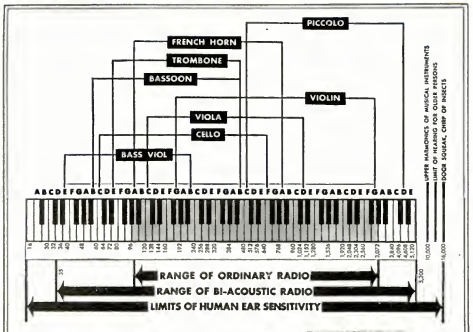
What is *Bi-Acoustic* Radio?

A simple technical explanation of this marvelous new RCA Victor Radio that gives 2 more octaves of music

"My Master's Voice on the Air"

A few weeks ago, RCA Victor introduced its latest, newest radio . . . the Bi-Acoustic. Thousands upon thousands who have heard it, marvel. This new radio *has* something others have always lacked. What is it?

It's the radio that adds two full octaves of music (amounting in the full orchestra to 266 extra musical tones) . . . in short, it is "Bi-Acoustic." We use the word "Acoustic" because this radio represents a tremendous advance in the perfection of tone quality, fidelity and frequency range, all of which are acoustical properties. We use the prefix "Bi" (the symbol for twofold), for in this new circuit there is twice the range, twice the reserve power, twice the tone quality.



This scale chart shows you exactly how much more music you get in a Bi-Acoustic Radio—in a full orchestra amounting to 266 extra musical tones.

Marked by 9 New Features

Nine sensational advancements make Bi-Acoustic Tone possible. Specifically, the new Bi-Acoustic radio incorporates the following features: (1) "B" Amplification increases fidelity, prevents amplifier "overspill." (2) Automatic Tone Compensation increases audibility, removes metallic harshness of sound at low volume levels. (3) Dual Automatic Volume Control reduces noise between stations, holds volume at the level you want—always. (4) Extended Musical Range makes possible the reproduction of two additional octaves as shown in the above scale chart. You hear full, true notes you have never really heard before—piano notes, piccolo notes, saxophone notes. (5) Tone Equalizers prevent cabinet "boom." (6) An Improved Loud Speaker brings final reproduction still closer to the original performance. (7) New Type Radiotrons improve operating efficiency. (8) The new "Background" Noise Suppressor. (9) New Cabinetry, splendid in appearance, provides ample baffle area for the creation of the finest tone in radio.

You Hear ALL Tones

These features make possible the first radio to actually *duplicate* a broadcast—rather than merely approximate it. All in all, technically and acoustically, this new radio reaches the apex of performance.

Come in to any RCA Victor dealer, listen to, and examine the mechanics of this instrument. Put it to any test you want—it will win. There is no obligation, for whether you buy or not, we would like you to see and hear it. Frankly, we believe you will be amazed!

THE NEW R-78 "BI-ACOUSTIC"—12-tube Superheterodyne with "B" Amplification, Advanced Automatic Tone Compensator, Tone Equalizers, Dual Automatic Volume Control, Noise Suppressor, Micro Tone Control.

We have an interesting booklet telling in more detail the story of Bi-Acoustic Radio. We know you will enjoy reading it . . . so clip and mail the coupon NOW.

MAIL THIS COUPON TODAY

The RCA Victor Co., Inc.
Advertising Dept., Desk S-12
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POPULAR SCIENCE
FOUNDED MONTHLY 1872

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December, 1932, Vol. 121, No. 6. **Popular Science Monthly** is published monthly at 381 Fourth Avenue, New York, N. Y., by the Popular Science Publishing Co., Inc. A. L. Cole, President and Treasurer; R. C. Wilson, Vice President; John Nichols, Vice President; F. W. Briggs, Sec'y. Entered as second-class matter Dec 28, 1918, at the Post Office at New York under the act of March 3, 1879; additional entry as second-class matter at Dayton, Ohio. Entered as second-class matter at the Post Office Department, Canada. Printed in U. S. A. Copyright, 1932, by the Popular Science Publishing Co., Inc. Single copy, 15 cents (20 cents in Canada). Yearly subscriptions to United States and its possessions, $1.50; foreign countries, including Canada, $2. Subscribers must notify us of change of address four weeks in advance of the next publication date. Be sure to give both old and new address. The contents of this magazine must not be reprinted without permission. The editors are not responsible for unsolicited contributions, and cannot guarantee the return of such material or insure against its loss. Contributions not accompanied by sufficient postage will not be returned. In presenting numerous stories of new products of applied science, **Popular Science Monthly** does not underwrite the business methods of the individuals or concerns producing them. The use of **Popular Science Monthly** articles for stock-selling schemes is never authorized.

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(Continued from page 2)

NEW DEVICES FOR THE HOME

NEW PROCESSES AND INVENTIONS

UNUSUAL FACTS AND IDEAS

FOR THE HOME OWNER

WOODWORKING

IDEAS FOR THE HANDY MAN

BEGINNING IN THIS ISSUE:

TRIUMPHS OF SURGERY

Thrilling incidents of which the layman seldom hears are given you here in one of the most dramatic stories of the twentieth century . . . PAGE 15

What You Can Do with a Microscope

Here's a new hobby as fascinating as it is easy on your pocketbook, with complete instructions telling you how to begin and what to buy . . . PAGE 52

AND important articles that will keep you abreast of the very latest advances in aviation and engineering—special new home workshop, radio, and automobile features

A plain statement

ANTI-

IMPORTANT INFORMATION FOR THE

In an effort to clear up the confusion regarding anti-freeze, which appears to exist in the minds of many consumers, we give below the outstanding facts. The following statements are guaranteed to be correct and accurate in every particular. They are supported by the highest scientific authorities.

THE problem of preventing freezing in the cooling-systems of automobiles during the cold weather months was one that taxed the ingenuity of car owners for many years. Salt, honey, alcohol, kerosene, glycerine and many other products and by-products were used with varying success. Within the past few years, however, there has been developed a new product, a product specially designed for this one use and purpose.

That product is Eveready Prestone. It is not a general commodity used principally for other purposes: it is an anti-freeze, and nothing else. It is a scientific development, thoroughly approved by all car manufacturers; a product which embodies all the advantages of all materials previously used, with none of their inherent weaknesses.

In developing Eveready Prestone, the laboratories of Union Carbide and Carbon Corporation, keeping in mind the requirements of the U. S. Bureau of Standards for an ideal anti-freeze, worked toward a product which would satisfy the following specifications:

1. It must not boil away. A boil-away anti-freeze is both an inconvenience and a poor protector against sudden changes in the weather. Such anti-freeze requires frequent renewals and leaves the car unprotected when a cold snap follows warm weather.

2. It must be harmless to the cooling-system. An anti-freeze which corrodes the cooling-system is a poor product to put in a car.

3. It must be effective in preventing freezing. The effectiveness of the materials commonly used before the advent of Eveready Prestone varied over a wide range. Some were effective in preventing freezing; others were not.

4. It must not affect the car finish. The fumes of boil-away products were a source of danger to the finish of fine cars. This was a weakness which those who developed Eveready Prestone were anxious to avoid.

5. It must circulate freely at the lowest operating temperatures. A heavy, viscous material, which is not free-flowing, is obviously a poor cooling-agent.

6. It must be non-inflammable and odorless. Winter driving was often made unpleasant by smelly fumes,

# of facts concerning

FREEZE

PROTECTION OF CAR OWNERS

while inflammable mixtures held the possibility of causing serious accidents.

7. It must not "creep." Certain materials in common use had a strong tendency to leak out of systems which were tight enough to hold water but not tight enough to hold these materials. The new product, it was felt, must have *less tendency to leak than water.* Consequently, if a car could hold water it would hold the anti-freeze.

8. It must be packaged as a concentrated product. Many of the products which the public was using, because of their thick, heavy nature in the concentrated form, were sold as water-diluted solutions. The cost of canning and shipping plain water was thus borne by the public. Obviously, if a concentrated product could be packaged and sold the user could be saved that expense. Furthermore, the public had no way of telling how much of these diluted solutions was anti-freeze material and how much was ordinary water. Some brands contained as much as 55% plain water: others contained less. It was decided, therefore, that the new product must be concentrated. Thus the public could be sure of buying a standard product, always the same and always of known value.

9. It must be economical. The laboratories which developed the new product were not interested in low first-cost per gallon. They *were* interested in low cost per season. It was felt that car owners who had been buying boil-away anti-freeze on the installment plan, a few quarts at a time, would not object to a relatively high first-cost if the *all-season* cost were low. The new product, therefore, was priced to cost, for an average winter season, no more than the cost of boil-away anti-freeze.

Thus was developed Eveready Prestone, the only anti-freeze which meets *all* these requirements. But laboratory effort did not stop with that.

A NEW AND IMPROVED PRODUCT AT A LOWER PRICE

Further research developed the product to a point where it gave protection not only against freezing but also against rust and corrosion in the cooling-system. And such is the *new* Eveready Prestone. Its use reduces the corrosive action of water on the metals of the cooling-system as follows: brass, copper, solder, aluminum and zinc, 75%; cast iron, 95%. No other "treated" anti-freeze compares with Eveready Prestone for the prevention of rust and corrosion.

The new Eveready Prestone has been reduced in price. It now offers by far the safest and most economical protection against both freezing and corrosion. The car owner who uses Eveready Prestone is assured of complete protection through all weather changes, freedom from worry and the trouble of replacements, and a clean, rust-free radiator. He insures his car, not only against a freeze-up, but also against the costly repairs that follow a rust-clogged and corroded cooling-system. He prolongs the life of his car.

• • •

National Carbon Company, Inc., Unit of Union Carbide and Carbon Corporation, New York, N. Y.

What Makes BUILDING and LOANS *So Safe?*

By LEON MEADOW, *Financial Editor*

"I WANT to learn all about building and loan associations," John Carr told George Badger, the man to whom he had been referred by the girl at the information desk. "I came in without any intention of investing money, but if your story is convincing enough, I can be sold."

Ordinarily Badger had no time for answering such general inquiries. But in this case, he saw the wisdom of selling Carr and, through him, many men of his type. "Well," he started, "to begin at the beginning, the first building and loan society in this country was formed at Frankford, Pennsylvania, in 1831. Its total assets to start were $224, and its sole purpose was to provide funds to secure homes for every citizen of that small town. Other than that, the society had no reason or plan for further existence. But the idea was too good to stop there. Today, 101 years later, there are over 11,000 building and loan associations with total assets of almost nine billion dollars in business, and their scope is somewhat broader than that of the original society.

"HERE is how the typical association now operates: First, taking the membership side of the picture, there are three distinct types of shares which may be purchased by members. One is the installment share—the original, and still most popular of all three. Members subscribe for shares of stock which have a fixed par value. By periodic payments of small amounts these shares are matured, and to them at regular dividend dates are added the dividends earned by the association. Because this dividend rate varies from year to year, the time required for the maturity of installment shares is dependent upon the prevailing dividend rates and also upon the size of the installment payments made by the subscriber.

"The next type is that of prepaid shares. These are designed for larger sums of money and are paid for in a lump sum at the time of subscription. This sum is equal to the amount which will mature these shares in a given period of time, at current dividend rates. Accumulated dividends are credited to the shares subscribed for, and eventually they mature at par.

"The third type is called full paid or income shares, and they provide another kind of investment for larger sums of money. Subscribers pay par value for these shares at the time of subscription, and receive cash dividends at each dividend date of the association."

"You've said a lot about dividends, Mr. Badger, and I understand from you that they vary from year to year. What is the average dividend rate now?"

"Figures for 1932 aren't completed yet. But the figures for 1931—and you know what kind of a year that was—showed that shareholders throughout the country received close to half a billion dollars in dividends—an average of 5½% on their investments. As a matter of fact, the earnings of all associations compared favorably with those of other years. In no recorded cases did they drop more than 1% from the dividend rates of 1930.

"The money deposited in building and loan associations by share holders is invested in mortgage loans on owner occupied homes. The associations are the only institutions in our money and credit structure which confine their lending operations to home financing, and provide this home-owner credit on the specialized plan of an amortized mortgage."

"How does that work?" asked Carr.

"It allows," replied Badger, "for periodic repayment of the principal of the loan, as well as interest on the mortgage, out of the current earnings of the borrower. These payments are usually on a monthly basis, interest and principal sums being lumped together to give the borrower a fixed obligation each month to the association. As you can see this plan steadily decreases the company's risk on any given loan. The period for repayment of these loans runs, as a rule, from eight to eleven years, depending upon the size of the installments. When the loan is made the borrower signs an agreement to make these regular payments. His personal note is secured by the mortgage which is an actual lien on the property pledged.

"The amortization provided for by monthly payments gives a building and loan association a contractual income from all its loans and reduces the actual amount outstanding on each by from 9 to 12½% a year, according to the length of the loan. And—here's the big point—because of this constant reduction of the amount outstanding on any particular loan, building and loan associations have found it possible to lend up to 65% of the home value. And what's more, this high percentage financing is done by these associations without any of the harrassing charges of second mortgages. Mortgages held by organizations like ours are ranked for safety quite as high and higher in many cases than any straight mortgage limited to 50% of the home valuation.

"All these associations are organized on a local basis. They confine their lending operations to a relatively small locality, within quick access of the association officers who make appraisals, check home construction and investigate borrowers. For this reason, and because their financing plan makes possible 65% loans,

building and loan association lending operations reach a field which banks and insurance companies cannot hope to cover, the field of really small home-owners and futhermore it's a mighty safe field, too.

"The average size of loans made by associations from 1920 to 1930 was $3,550. Based on 65% loan of total value, the average home on which the associations have lent money would be worth about $5,300. This reflects a certain type of citizen—the steady, dependable working man who wants to keep his family together, and can acquire the stability of home-ownership only by paying off a home mortgage by installments.

"An outstanding feature of building and loan conditions in 1931 was the surprising readiness with which borrowers continued their monthly repayments of principal in the face of cut incomes, reduced salaries and unemployment. Home financing experts draw two conclusions from this record: one, that the class to which associations lend was not hit so hard by actual unemployment, and where income was curtailed the family was prone to sacrifice luxuries in order to maintain an equity in the home; two, that there is no more stable debtor class anywhere in the country than these home-owner borrowers.

"LET me give you a brief idea of how popular building and loan societies have grown. From 1920 to 1930 assets invested in all these associations more than tripled themselves, rising from two and a half billion dollars to over eight billions. During this same period, the investors and borrowers have more than doubled their number, growing from 5,000,000 to over 11,000,000. In 1920 there were 8,633 associations. At the end of 1931 there were 11,442 in operation."

Badger sat back in his chair and lit a cigarette. For a minute he was silent, and then he turned to John Carr. "Mr. Carr, you came in here to learn about the operations of building and loan societies. But I gather that you are just as much interested in their safety. Is that true?"

John Carr smiled. "It is. That was the main question in the back of my mind. One thing that bothered me was strengthened by all your emphasis on mortgages. If all, or practically all, of your money goes into mortgages, what kind of a record can building and loan associations show in these days of vanishing real estate values? How have they held up during 1931 and 1932?

"Your question is well taken," Badger said. "Again the answer is in the figures. In 1930, 190 building and loan associations failed. This was 1.6% of the total of 11,777 in operation. In 1931 the percentage was 1.1%. Figures for 1932, though not completed, will show a further decrease. I think that these figures speak for themselves, but if you wish to draw a comparison that will make this fine record seem even more amazing, take the bank suspension figures for 1931. With something less than 20,000 commercial banks in the country, 2300 were suspended in that year. That's more than 10%."

Carr glanced at his watch and rose. "I'm satisfied, convinced and sold, Mr. Badger. And I think the Ajax Building and Loan Association will have a new member soon."

The door is open! . . prove that he can win

ALL they needed was a *chance.* All they asked was an *opportunity* to show the stuff they were made of. Then they got busy and made the world pay attention!

Maybe you feel the same way about it. Maybe you, too, are ambitious—eager—willing to work hard for recognition that will mean real success in life.

Well, the door isn't closed. OPPORTUNITY herself is holding it wide open!

Never before has the world so keenly felt the need of *skilled craftsmen*—men who can use their hands as well as their heads—who can design and build and superintend others in building the fine things modern civilization demands.

Five hundred years ago it was easier to find such men than it is today! Why? Because then the Guilds flourished. Through them, boys and young men were trained to proficiency in manual arts.

Now the very spirit of those great societies has been revived in the Fisher Body Craftsman's Guild, which every boy in the United States and Canada may join.

Organized only two years ago, this modern Guild has already started thousands of boys on their way toward real achievement.

To foster the competitive spirit which means so much in work or play, the Guild sponsors annual competitions, and has distributed more than 2,000 awards for outstanding merit in craftsmanship. The third competition, now in progress, is described on the opposite page.

RAYMOND SMITH
Lawton, Okla.

FRED FRIEDRICH
Rochester, N. Y.

★

These boys have earned 4-year University Scholarships

★

HOWARD JENNINGS
Denver, Colo.

DONALD C. BURNHAM
West Lafayette, Ind.

FRANZ IBISCH
Columbus, Wis.

GORDON L. DRUMMOND
Washington, D. C.

ALBERT FISCHER
Waukegan, Ill.

RAYMOND DOERR
Battle Creek, Mich.

F I S H E R B O D Y

. . . who will enter and success in life?

NOW SIX UNIVERSITY SCHOLARSHIPS

Each Valued at $5,000!

As further incentive to the boy craftsmen of the United States and Canada, the Fisher Body Craftsman's Guild announces the addition of two more University Scholarships valued at $5,000 each, raising the total number of annual Guild Scholarships to six. Four of these scholarships will go to boys of the United States, two Senior and two Junior. Two scholarships will go to Canadian boys, one Senior and one Junior. You can see for yourself how this increases *your* opportunity to earn one of these awards, since now boys of the United States exclusively will compete for four scholarships, while boys in Canada are assured of two scholarships for themselves.

A brilliant future for you may lie in this opportunity to demonstrate your manual skill, your ambition, and your willingness to work

Awards valued at more than $85,000 will be divided among boys who take part in the third annual competition of the Fisher Body Craftsman's Guild. All boys between the ages of 12 and 19 years may enter, and there are no dues or fees of any kind to pay.

Winners of Junior and Senior awards in each state and each Canadian district (112 boys in all) will be delegates and guests at a great Convention to be held in Chicago at the time of the "Century of Progress" Exposition.

Here will be presented the six university scholarships, valued at $5,000 each, which constitute the major awards for outstanding craftsmanship.

Any ambitious boy with two hands, and a head on his shoulders, can do the work assigned for this competition. Just how *well* he does it—how high he stands when the awards are made—will depend entirely on his desire and ability to excel and his willingness to stick to the job until it is finished.

The judges in this contest, as in preceding ones, are outstanding educators and men who stand high in the knowledge of craftsmanship. At their head as Honorary President of the Guild is Daniel Carter Beard, National Boy Scout Commissioner. Honorary President of the Canadian Section is John A. Stiles, Dominion Commissioner for Scouting.

Join the Guild and enter the competition. Meet other ambitious boys—make lifelong friendships—and aim at the highest award, a four-year university scholarship!

Don't waste a minute. Get going NOW!

HOW TO BECOME A GUILD MEMBER

It's easy to become a Guild member. Just go to any dealer in General Motors cars (Cadillac-LaSalle, Buick, Oldsmobile, Pontiac, Chevrolet) and say you want to join. He will do the rest. Your Manual Training Teacher also can take your application—or the local Boy Scout Leader. Or you can simply fill out the coupon at the right and mail it to Guild headquarters. Shortly after enrolling you will receive your membership card, an official Guild button, and complete information about the Guild craftsmanship competition for 1933.

Fisher Body Craftsman's Guild Enrollment Coupon

(Please print plainly in all spaces below)

Boy's Name_____

Enrolled Before ☐ Yes ☐ No

Born_____ day of_____
Month Year

Address_____

City_____ State_____

Name of Your School_____

Manual Training Teacher_____

Principal_____

Grade_____

Parent or Guardian's Name_____

Address_____

City_____ State_____

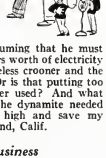
Mail this coupon at once to Guild Headquarters, General Motors Building, Detroit, Michigan E

CRAFTSMAN'S GUILD

Our Readers Say

That's All Right, But Where Do You Get the Cent?

HERE'S one I ran across that might be interesting to your readers: A cent's worth of electricity would furnisb power to keep a musical note sounding on a radio set from now for sixty million years. Radio, tbey tell us, is one of the most sensitive instruments ever devised and will produce an audible sound on a billionth of a watt of electricity. Can some of our readers tell us the answer, tben, to this one: As I listen, in spite of myself, to my neighbor's radio, am I right in assuming that he must be using at least ten dollars worth of electricity to get tbat seemingly tireless crooner and the shaving soap ad man? Or is that putting too low a price on the power used? And what would be the value of the dynamite needed to blow 'em both sky high and save my poor ears?—P.D., Oakland, Calif.



That Evolution Business Bobs Up Once More

IN A recent issue of POPULAR SCIENCE MONTHLY, M.S.R., Electra, Tex., says if one accepts tbe theory that man descended from apes, he must reject the statement that man descended from Adam and Eve, which the Bible teaches us to believe. Does evolution teach tbat man descended from an ape or does it teach that tbe branch of the ape family and the branch of the man family had a common origin, and man will always be a man and an ape an ape? It has been agreed by all, that man bas two natures, an animal and a spiritual nature. There is no doubt, be got bis animal nature from tbe same place the animals got theirs, and developed along tbe lines as outlined in POPULAR SCIENCE MONTHLY by Mr. Mok a few months ago. As it took a long wbile to develop the animal nature, it no doubt took as long to develop the spiritual nature, and for that purpose the Lord put Adam and Eve in the garden of Eden. In order that the spiritual nature should not be hampered by the animal, the Lord caused a deep sleep to come over Adam and from his rib made a woman, and he did not snap out of it till they ate of the forbidden fruit.—W.L.H., Larned, Kan.

After all, It's Merely a Question of Backbone

WILL you please ask your readers to answer this one for me: Authorities say that we are taller when we lie down than when we stand up. In some cases, the difference amounts to an incb. The wise acres say that the difference is due to the fact that people don't stand straight. I think that's all bunk. I feel the difference is due to the weight thrown upon the cartilage between the vertebrae. Am I right or wrong?—C.W.G., Des Moines, Iowa.

We Thought We Had Already Told All About Auto Racing

THIS is a request from a reader who has read your magazine for a number of years. Every month when the new issue arrives, I first read the pages entitled, "Our Readers Say." There I bave read what others want and so I should like to make this request: I should like an article on auto racing, something that will tell us bow these cars are built, and a general description as to bow they work, and of what value tbey are to the automobiles that we drive today. I wonder how many others would be interested in this same subject.—P.B.R., Erdenheim, Pa.

Here's One Reason Why Water in Diesel Engine Won't Work

I HAVE read POPULAR SCIENCE MONTHLY for some time, but the problem of V.E.J., Pasadena, Calif., got my goat. What could be more illogical than to run a Diesel engine by spraying water into tbe hot cylinders in place of oil? He says there must be something wrong with it or someone would have tried it before. He's right! There is something wrong. It would be quite a job to keep the cylinders hot, would it not, if you sprayed cold water into them? You might use a blow torch. Pardon my saracasm. May I ask a question? Has M. J.H., Fleetwood, N. Y., figured out the problem of insulating a thousand-foot lightning flash so that it won't electrocute his own troops? That's enough of questions for one time. I like your magazine and am especially interested in the plans for the kayak canoe. How about some more advanced chemistry?—L.W.Z., Neenah, Wisc.

Suggests Some Improvements for Vortex Tube

IS THE idea of the Vortex Tube, described in a recent issue, supposed to be serious or did you forget to put the title "SCIENTIFICKS" at tbe top of the page? It seems to me somebody's goofy somewhere. Wouldn't this tube be too clumsy to move around and if it was collapsible and drawn into the salvage barge, wouldn't it be a lot more trouble than the artificial lung and some of the less complicated inventions? How could the paddles revolve fast enough to keep the water against tbe sides of the tube all the way up, especially if the water was very deep? Wouldn't it be better, if you had to use the tube, to put a bottom on it and a suction grip to hold it to the submarine? Then a hatcb in the bottom could be opened over the batch in the sub and the men pass from one to the other and climb a ladder to safety. Come on, fellers, let me know what you think of the idea. Maybe I'm the goofy'un. My heartiest congratulations to POPULAR SCIENCE. You've sure got a great magazine. Let's have some more radio though. Tell us what makes a radio work. What does each part do and how? I'm sure I'm not the only bug that wants to know.—J.W.R., Ashville, N. C.

But You Shouldn't Believe Everything You Hear

ALL my life I've harbored the notion that cutting the hair frequently will make it grow thicker and coarser. Probably many of your bald-headed readers have thougbt the same thing. Now along comes the American Medical Association and tells me I'm all wet, tbat cutting hair bas no effect on it and, by the very nature of things, can't have any effect. Will some one who knows kindly tell me wbo's right? I've no more hair than a billiard ball and cutting and even shaving have left it invisible to the naked eye. Has any one any different experience to report?—J.B.W., Butte, Mont.

How Wonderful Is Man When He is Seen Inside and Out

I UNDERSTAND that a robot, called the "transparent man," will be exhibited at the World's Fair at Chicago next year. This robot will show what goes on inside one when one swallows, chews, eats, or sleeps. That should be interesting—and maybe instructive. But will this transparent man show the processes of metabolism, the action of the endocrine glands, tbe slow processes of the lymphatic system? I pause for a reply. Until these subtle operations are made visible, what can we know about the buman body? And there are operations even more obscure, such, for instance, as the things that occur in the brain, which no robot with which I am familiar is able to show. Aren't these the things in which we, as fundamental scientists, are most interested? Give us a spiritual robot and stop chattering.—H. F., Peekskill, N. Y.

Electricity Did the Trick And Not Visiting Ghosts

HOOEY, tosh, and likewise bosh! That's all I have to say about the bell ringing article by W.B. M. The bell probably was rung by an attendent by electricity from an adjoining room. It may have been run by a spring mechanism tripped off by something the person approaching stepped on. Or, again, an X-ray may have been turned upon a selenium cell and when it was interrupted by the approaching person, the cell operated an

electric switch that rang it. There are many ways in which it could have been rung but one thing is certain and that is that no spirits or supernatural being did it, as that is impossible.—D.F.C., Mankato, Minn.

If Your Nerves Are Bad, Leave This One Alone

THIS is what I should like to ask one of your smart readers to solve for me: Mrs. Smith has twenty-seven cows, and Mrs. Murphy has twice as many chickens as Farmer Browns bens lay eggs. Now, if one half of the number of pails of milk that Mrs. Smiths cows give cost seven times as much as one-tenth as much as Mrs. Murphys chickens cost per pound how much more would Farmer Brown get for a dozen eggs if three times the number of calves that Mrs. Smiths cows had were equal to one and one-tenth times more than the number of worms that Mrs. Murphys chickens catch in twenty-four hours, if each chicken catches seven and a half worms in three minutes and ten seconds. Send me a telegram when someone figures it out. . . Tbe real reason of this letter is to ask for the continuation of the amateur radio section by Mr. Carr, and to say that if Ray Wailes stops his chemistry section, I'll shoot him.—V.A.H., Long Beach, L. I., N. Y.

Here's the Latest Report On the Ice-Water Problem

I WISH you would ask W.M.G. of Port Washington, N. Y., not to try to mix us up. Tell him not to expect too much from his thermometer—it measures temperature alone' —and temperature is only the indication of the presence of heat. The amount, or quantity, of heat is measured by b.t.u.'s., those little things which make the world go on. There is more beat in 100 lbs. of ice than there is in 1 lb. of ice. The temperature is the same. Also it takes a certain well established amount of heat to change a given quantity of ice to water—to change the physical state—and this change takes place with no change in the temperature or thermometer. This amount of beat is called the Latent Heat of Fusion of Ice and is equal to 144 b.t.u.'s.· A mixture of ice and water will give a temperature of 0°C—if we add heat we finally get water at 0°C, and if we take beat away we get ice at 0°C. A given quantity of water at 0°C contains more b.t.u.'s. tban tbe same quantity of ice at the same temperature. And all this makes it just too bad for perpetual motion.—F.W.V., Lake Linden, Mich.

Wise People Believe in This Poisonous Hop Toad

I READ somewhere about a monster toad in Mexico that throws out a poison fatal to animals. The poison is odorless but powerful and is supposed to kill at a distance of some feet. I read of a small dog that was killed by the poison in half an hour. Other dogs, biting the toad, died within two or three minutes. Is this all so much bologna? Or is there an element of truth in it? And if so, how much? What is the effect of the poison on human beings?—L.D., White Plains, N. Y.

"Black" Objects He Sees As Something Not Black

I WANT to report a phenomenon which I have observed in the realm of optics. I can't account for it nor have I read anything about it anywhere. I have noticed that a piece of coal, the black fender of a car, a black piece of phonograph record, and many other things are not the black color they appear to be. If you look at coal in bright sunlight with the naked eye or through a small lens, you will find its black surface composed of tiny, almost microscopic points of different colored light. If you move the object as you look, you will see what seems to be an effect of all the color points shifting or moving over the surface. Black is one of the best backgrounds against which to look for this effect and the surface should be smooth. I have detected the phenomenon on many other objects of different color and composition. The silt-painted radiator, the aluminum painted fire plug, a copper coin, silver coin, a green leaf, brass articles, black print letters, other colored parts of pictures, and even on white paper itself. It is now my pet theory that this effect probably exists on all surfaces of all materials whether we can see it or not.—A.V., New York, N. Y.

There May Be Life in The Old Girl, Venus, in Spite of All

I GOT to thinking about this one the other day and I thought I'd write you for information. Those who pretend to know tell us Venus has an atmosphere seventy-seven to eighty-eight miles thicker than ours, and in this atmosphere they find carbon-dioxide. On Venus itself there are faint green markings that are thought to suggest the presence of vegetation. If all this is true, is there life on Venus? What kind of life? And what does it mean as viewed from the standpoint of our development? Are we dragging along, or are we strutting in the van? How would life on Venus fit in with evolution and the theory of special creation? Maybe, the remarkable ancients were right and we're merely headed for another planet and more experiences. If so, how do we get to Venus when we shuffle off this mortal coil?—L.B.T., Greenwood Lake, N. Y.

First Class Reason Why You Should Buy Now

NEWSPAPERS, billboards, radio orators, and the rest of the machinery for molding public opinion have been quite busy of late in a rather praisewortby effort to end the depression. The solution offered is simple. Let the public start buying and straightway business will pick up and the depression will be over. Fine! You can find no more flaws in that argument than you can in a statement that if the sun rises in a cloudless sky we'll have a clear day. But the editorial writers, advertisers, and broadcasting economists proceed immediately to trip over their own feet by urging the public to buy "as a patriotic duty." My eye! says I. There are two, and only two reasons for buying anything today. First, because you want or need something and have the money to pay for it; second, because prices generally are at such levels that almost anything bought today is a bargain. That's the common sense of it and patriotism, charity, or any other altruistic motive enters into the thing not at all. The principal reason why buying has lagged and the country is in a slump is fear; in most cases unreasoning, indefensible, foolish fear. The head of a business doesn't buy a new car for fear of the opinion of employes whose salaries have been reduced. His employes won't buy new clothes for fear of the effect on the boss. And so on, down the line, merchant watches customer, customer watches merchant, debtor watches creditor, neighbor watches neighbor, all holding back and making what they have "do" until things pick up. Pick up—how? Business can pick up only if those of us who are not entirely destitute decide to buy what we need at the present bargain prices, not from duty, not with any sense of doing a fine or noble thing, but merely because it is the normal, natural thing to do.—A.L.K., Rochester, N. Y.

This Ear Language Is Hard to Master

SINCE reading your article "Spot Crooks by Their Ears" in the November issue, I've kept my eyes open and have spotted flap ears in the most unexpected places. One of the best doctors in town has flap ears. My favorite minister has 'em. The president of one of our biggest banks has them. Not a breath of scandal bas ever touched any one of these people. So what? Each is above the average in intelligence and I'd bet my last cent they're all honest. That ears are different and can be used as identification tags, I can believe, but that one kind of ear means a crook and another kind an honest man is too much for me to swallow. Do you suppose it's possible Dr. Kilmer is being the least bit overenthusiastic? Pioneers in other fields have exaggerated.—F.P.S., Denver Colo.

It's Possible This Old Earth Won't Explode

YOU can tell C.E.A., Mason City, Iowa that the heat at the interior of the earth is caused (according to one tbeory) by the pressure exerted upon the center when the earth solidified. Most of this heat is far below the heat of a volcano, so the earth heat can be eliminated. However, shifting of the earth's crust causes heat, but it is usually too slow to cause an explosion. The gas and oil are under stable pressure, and cannot explode without oxygen. Most volcanoes are caused by sudden pressure creating steam. The water enters through cracks in rocks that have been broken by earthquake. I hope I have explained clearly if not I shall endeavor to prove by mathematics or authority.—A.H.N., Mt. Washington, Ohio.

Don't Leave It to Us; We Don't Want Any Part of It

I'LL leave it to you—isn't English, as she is spelled, a queer bird? Just go crazy with me and suppose you started out to spell the simple word "potato" exactly as many other words in our astounding language are spelled. You'd take "p" sound in cough, and start with gh. Instead of "o" you write ough as in dough. You'd take the "t" from phthisic, the "a" from neigh, the "t" from gazette and the "o" from beau. So you'd spell potato, ghoughphtheightteau. Not even Ireland would be able to handle that tatie. Is there, I ask you, any sense to the manner in which we spell the words in the English language? And yet some people are fussy about following the spelling in the dictionary! —R.D., New York, N. Y.

Take a LOOK at the private life of Ethyl Gasoline

GASOLINES are like people. Some are always well behaved. Others can't be trusted out of sight.

Most regular gasoline, for example, has hysterics when you call on it for extra work. It literally blows up—wastes its power in harmful knock. But you can trust *Ethyl Gasoline*. It always buckles down to work, delivers power with a smoothly increasing pressure that makes your car run at its best.

How do we know all this? Just recently a group of engineers played detective on gasoline. Through thick quartz glass windows they snooped into its private life. With special high-speed cameras, they took photographs of the actual combustion of motor fuels.

Look at the pictures below. At the left, a typical photograph of the antics of ordinary gasoline in a modern high compression engine. Compare it with the picture on the right. There's Ethyl Gasoline burning smoothly, steadily—producing *more* power and *less* wasteful, harmful heat.

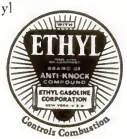
Behind your wheel you *feel* this difference. Start using Ethyl Gasoline today. It is a motor fuel that you can trust to give you the utmost performance of your car and at the same time protect your motor from wear and tear, excessive choking in starting and overheating on hard runs. Ethyl Gasoline Corporation, New York City.

Slow-motion movies of gasoline combustion

UNEVEN COMBUSTION of ordinary gasoline. Through a quartz window in the cylinder head of a modern high compression motor, Detroit engineers took this photograph of the uneven, wasteful explosion of ordinary gasoline. That white-hot, vertical line is *knock*.

SMOOTH COMBUSTION of Ethyl Gasoline. There's no trace of knock here. Note the even progress of the flame—the greater spread of power. Ethyl controls combustion; delivers *more* power to your piston, leaves *less* waste heat. It brings out the best performance of *any* car.

Ethyl fluid contains lead © E. G. C. 1932



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POPULAR SCIENCE
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RAYMOND J. BROWN, *Editor*

SIXTY-FIRST YEAR

Amazing Facts about Today's

Triumphs of Surgery

The first of a series of Articles describing the wonders worked in modern hospitals

By FREDERIC DAMRAU, M.D.

ONE of the most dramatic stories of the Twentieth Century remains virtually untold. This is the story of modern surgery.

Tradition and ethics of the medical profession prevent the surgeon from reporting to the press his own accomplishments. A wall of silence surrounds his work. Even well-informed persons know little of the miracles of life-saving which these white-robed figures perform behind the closed doors of the operating room.

Unknown to the general public, a revolution in surgical methods has been going on since the turn of the new century. New anesthetics, new disinfectants, new methods of diagnosis, new mechanical aids that shorten the time and lessen the shock of an operation, have been developed. It is the swift-moving story of such little-known marvels that this series will present to the readers of POPULAR SCIENCE MONTHLY.

With the full equipment of a modern operating room at his disposal, and with ample time for preparation, the present-day surgeon is master of cases that a few years ago were considered hopeless. But his skill and resources are tested most when he is fighting against time and tremendous odds during emergency operations. Under such conditions, surgeons are even called upon to bring back to life one whose heart has stopped!

I once witnessed a miracle of that kind in a New York City hospital. A surgeon, fighting to save the life of a young mother, had ordered an emergency abdominal operation. All was tense as the figure draped in white was wheeled into the operating room and lifted to the table.

Drop by drop the doctor at the head of the table poured the ether onto the mask over the patient's face. His fingers never left the pulse that was throbbing behind her jaw.

The surgeon cut the gleaming white flesh with a quick, long stroke of his blade. Then swift hands moved in and out of the wound, cutting, swabbing, clamping, and tying.

HOSPITALS AT SEA

Here is an emergency operating room on a big ocean liner. Attacks of appendicitis and accidents send most of the patients to this room where everything is securely fastened so movements of the ship will not interfere

An Untold Story of Thrills

AFTER many centuries of slow development, surgery has at last joined science to art and today in no other field of human activity are so many miracles of skill and precision performed. Of the vast advance made in this field, the public knows little. In these articles, the thrilling story of modern surgery, with actual experiences from the operating room, will be told by one whose life has been devoted to medicine and who is familiar with the facts.

With this sewing machine, which holds 300 clips, a surgeon can put stitches in stomach or intestines after an operation

"The patient is doing badly! The pulse is becoming more rapid!" was the warning from the assisting doctor at the head of the table.

This was the signal to finish the operation as soon as possible. Every additional moment under ether increased the danger. The surgical staff fought desperately against time, but the strain of the operation was too great.

"The patient has stopped breathing! The pulse is gone!" was the startled announcement.

The operation was stopped instantly. Down went the head of the table, in hope that reviving blood would flow by gravity to the vital nerve centers at the base of the brain and restore activity.

The surgeon placed his hand over the heart. It had stopped! The woman's lips were dark purple, almost black, and her skin was rapidly assuming the same ominous hue.

A quick hand passed to the nurse's tray and seized a small syringe with a long needle attached. It had been prepared beforehand for just such an emergency. It contained adrenalin, a powerful heart stimulant obtained from the small suprarenal glands located above the kidneys. It is used as a last resort.

Resolutely, the surgeon plunged the needle through the chest wall between the ribs lying over the heart. His thumb pressed the plunger, forcing the adrenalin solution right into the chambers of the heart itself.

In less than a minute, the stopped heart was beating again and the woman had been saved. We had seen a human being snatched from death by the foresight of a surgeon ready to fight a sudden relapse.

Had not the life-saving adrenalin been ready for instant use, the minute or two required to place it in the syringe would have made it too late. In emergency operations, split-seconds are precious; rapid decisions necessary.

One of the most remarkable cases of quick-witted daring I ever saw in an operating room occurred at the end of one of my rides as an ambulance surgeon at a New York City hospital.

On the crowded East Side, a jealous husband had shot his wife through the heart and then committed suicide by jumping from a window. The woman was deadly white, hardly breathing, when we pushed the stretcher through the milling crowd and placed her in the ambulance. All the way to the hospital, as we raced with clanging bell through traffic, she was sinking fast. I could feel her life slipping away like sand running through my fingers. Death seemed only a matter of moments.

At the hospital, the senior surgeon was waiting. The big reflecting light that throws no shadows had been snapped on above the operating table. White masks covered the faces of the nurses and the surgeon was slipping his hands into rubber gloves as we entered. Hastily, the anesthetic was administered. The surgeon had one gambling chance, a thousand to one shot, and he took it.

With lightning-quick strokes, he cut down to the ribs overlying the heart. Then he clipped through the bones with rongeurs, or surgical pincers, and opened a little window in the chest wall.

Within, we could see the heart fluttering feebly in convulsive final beats. We held our breath and waited for it to stop. Swiftly, the surgeon thrust one rubber-gloved hand into the opening. His fingers, encircling the failing heart, squeezed steadily and then relaxed their grip in regular rhythm until the normal beat returned.

Then he steadied the heart with his left hand, and with his right sewed the wound together. The woman, given up for dead when she entered the operating room, made a complete recovery.

As the surgeon works at the operating table, there must be no shadow to interfere with his vision. The light shown here casts no shadow but thoroughly illuminates the work

The photo at right, illustrates surgery without cutting. The doctor is demonstrating, on a piece of beef, the radio knife

Most people think that an injury to the heart means certain death. Usually it does. But occasionally a miracle of surgery, such as I have described, will save the life of a person even when the heart is seriously cut or torn.

I remember one example, with a curious climax, that occurred on the West Coast. A gambler was stabbed in the heart, the knife cutting a slit more than two inches long. In an emergency operation, the slit was sewed up. The operation would have been a complete success except for the patient. No sooner was he out of the hospital than he hunted up the man who had stabbed him. In the resulting brawl, the wound in his heart pulled open and he died before a second operation could be performed.

Recently a queer case of an injured heart puzzled Youngstown, Ohio, surgeons. A thirteen-year-old boy was accidentally shot in the chest by a playmate. The 22-caliber bullet pierced his heart. Yet he complained of no pain there. Instead, he reported severe pains in his left leg. X-ray photographs showed that the bullet, which had entered the heart without killing him, had been pumped out and carried by the bloodstream until it lodged in the artery feeding the left leg.

Bullet wounds frequently demand unusual emergency work. Not long ago, a Chicago surgeon performed an amazing emergency operation that saved the life of a bullet-riddled racketeer.

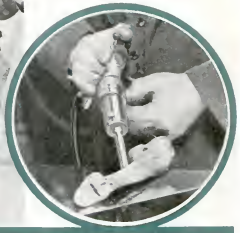
The gangster had just turned off Michigan Avenue when a taxicab whirled around the corner. Lead streaked from the weapons of crouching gunmen inside, and the victim, apparently dead, was left sprawled in the gutter. Twenty-four bullet holes had been torn in his intestines—each one likely to cause peritonitis due to the dripping of the intestinal contents. The inner tube of a tire could hardly be expected to be patched in that condition.

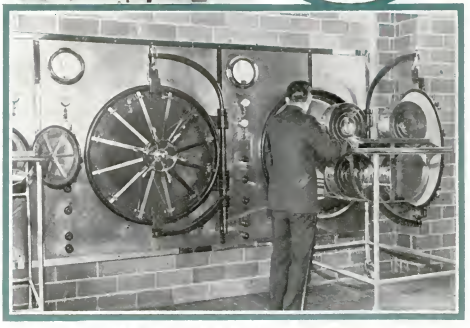
At the hospital, the surgeon examined every inch of the thirty feet of the intestine. A single hole let unrepaired would have frustrated the entire operation. As each perforation was discovered, the surgeon called for a special needle and extra-fine silk thread and so skillfully patched the delicate bowel that one would never know where the puncture had been. In a few weeks the patient was out of the hospital.

One type of emergency operation that is always a desperate race against time is saving a person from choking to death.

Sitting near a surgeon friend of mine at a dinner party recently was a fat, bald man who was in the act of swallowing a mouthful of food when he started to laugh uproariously. A piece of steak went down the wrong way. He sputtered, made strange noises, clutched frantically at his throat. The veins of his neck stood out as though they would burst. The guests turned him upsidedown and pounded *(Continued on page 112)*

Below, a pneumatic drill now used by surgeons in operating on bone where necessary to remove large sections





The sterilizing room of Mt. Sinai Hospital, New York, where all instruments are steamed clean

Dead Horse "Lives" *in Marvel of Taxidermy*

Great Australian Racer, Exhibited in Rare Mounting, Looks Ready for One More Contest

1 Skeleton of Phar Lap, held together with wire and steel rods. Afterwards it was completely covered inside and out with plaster

CROWDS packing the grandstands at Belmont Park, famous Long Island racetrack, received their biggest thrill recently from a horse not entered in the races—a horse that had died six months before!

Phar Lap, legendary wonder horse of Australia, rode by on a motor truck, neck arched, alert ears slanted forward, chestnut coat a silken sheen. Every muscle, every vein, every ripple of the skin was there. The magnificent animal had been "brought to life" by one of the most amazing pieces of scientific taxidermy on record.

After appearing at American tracks, where he had been expected to run this year, Phar Lap is going home. In Australia, the famous horse will be placed on permanent exhibition.

The career of Phar Lap—whose name is Javanese for lightning and means, literally, "wink of the sky"—is one of the most dramatic in turf history.

In 1927, the huge gelding, towering above other horses at the post, was shipped from England to Australia and sold at auction for $800. Within four years, his winnings had reached a total of $332,250, a mark exceeded only by Sun Beau's all-time record of $356,044!

In fifty-one starts, Phar Lap won thirty-seven races and came in second three times. Before he crossed the Pacific, last winter, for his American invasion, his huge leisurely stride had carried him to a secure place as one of the greatest race horses of all time.

Five attendants guarded him day and night after someone attempted to shoot him near Melbourne, two years ago. Because he was particularly fond of rolling in a certain kind of sand, a pile was provided for him wherever he went, and when he sailed for America, riding in a specially-built cabin, enough of his favorite New Zealand oats accompanied him to last for three months.

2 As the next step in re-creating the famous horse, skeleton and plaster were covered with sculptor's clay in which every muscle and line of the live body was carefully modeled in by the sculptor

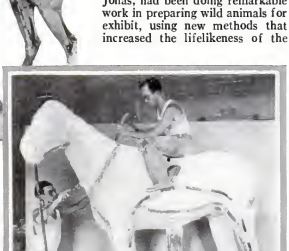
In his first appearance on this continent, he walked away with the $50,000 Agua Caliente Handicap.

Then came the end, sudden and dramatic as a flash of the lightning for which he was named. He had been taken to the Ed Perry Ranch, at Menlo Park, Calif., to rest between races. Early one morning, only two weeks after the Agua Caliente triumph, Tommy Woodcock, his trainer, who always slept within a few feet of his stall, found Phar Lap lying down. His owner, David J. Davis, was called from San Francisco. His veterinarian, Dr. Walter Nielsen, rushed to the stable. In spite of every effort, the great horse grew steadily worse and that afternoon, with tears in their eyes, the stablemen announced that Phar Lap was dead. Acute colic is believed to have been the cause of his sudden end.

A few days later, his owner announced that he would send Phar Lap's heart to an anatomical museum in Melbourne. The handsome chestnut hide he planned to have mounted by a taxidermist.

Then the difficulty arose of finding a taxidermist skillful enough to do the job. Although the skeleton of Sysonby, noted on American tracks a generation ago, had been placed on exhibition at the American Museum of Natural History, in New York City, no one had ever mounted a world-famous race horse.

On the other side of the continent, at Yonkers, N. Y., three brothers, Louis, John, and Leslie Jonas, had been doing remarkable work in preparing wild animals for exhibit, using new methods that increased the lifelikeness of the



3 Over sculptor's clay was next laid a coating of plaster of Paris, above. When dry, this plaster mold was removed in sections, some of which weighed over 270 pounds

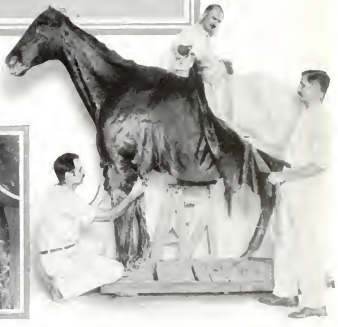
PHOTOS BY
HALBRAN

Which Horse Is Alive?

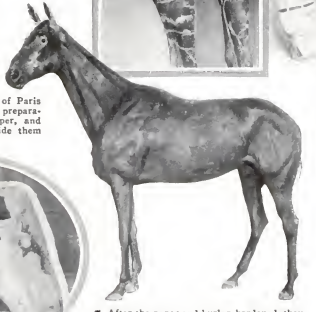
Can you, at a glance, tell the dead from the living in the picture at the left? James Butler's great handicap horse, Questionnaire, George Carroll up, is at the left and the recreated Phar Lap with Bert Crawford up, is at his right. This marvelous realism is due to the skill with which the great race horse's skin was prepared and mounted

subjects. Davis heard of their work and turned the reproduction of Phar Lap over to them.

Twice a day for two months, in preparation for the work, Louis Jonas visited the Empire City Track, in Yonkers, to watch the horses in their workouts. He studied them in every detail, paying special attention to the muscles of the legs. In addition, albums of photographs of the famous Australian racer were gone over as part of the painstaking study that preceded the four and a half months of intensive labor required for the actual mounting. Photographs, made during this time exclusively for POPULAR SCIENCE MONTHLY, illustrate the different phases of the work.



6 Into the mounting of paper and burlap, realistic veins were worked by means of rope covered with a special kind of paste



4 Each section of the plaster of Paris mold was coated with a wax preparation, below, and strips of paper, and burlap were pressed along inside them

5 After the paper and burlap hardened, they were removed from the sections and nailed together to form the mounting, above. This was shellacked and sprayed with sawdust

7 Here is the most difficult job of all. The Three Jonas brothers are putting Phar Lap's skin over the completed mounting upon which has been laid a secret plaster-like substance that is so pliable the taxidermists can sculpture life-like wrinkles in the skin after it has been permanently attached

As a first step, the bones of Phar Lap's skeleton were carefully fitted together and held in place by means of wire and steel rods. Then a thin layer of plaster was applied. This was allowed to harden and then sculptor's clay was spread over it.

Combining the art of the sculptor with that of the taxidermist, Louis Jonas then modeled the clay until every tendon and muscle was reproduced exactly as it had appeared in real life. Next, over the clay, the three brothers spread an inch-and-a half-thick layer of plaster of Paris. U-shaped steel bars were attached to each side to prevent *(Continued on page 110)*

Plaster Cast Covers Eye as Record of Its Movements Is Made

WITHOUT fatiguing a subject, delicate reactions of the eye can be recorded with a new device recently perfected in Paris, France, by the Russian scientist and sculptor, Serge Yourievitch. A plaster cast with one eye-hole is placed over the subject's face. Pressing against the hidden eye is a sensitive air sack connected with a recording instrument by means of a rubber hose. As the eye moves in coordination with the one that looks out of the eye-hole, changes in air pressure within the sack operate the instrument which keeps a multiple graph record of all such movements. The reaction of the eye to straight lines, circles, squares, and ellipses, is said to be important in diagnosing ocular troubles in their early stages. Yourievitch, who has been carrying on researches in connection with the human eye, announced to the Academy of Sciences in Paris, in 1929, his discovery that the eye moves with a rhythm of its own.

POLICE RADIO CAR HAS TRANSMITTER

TRANSMITTING sets are soon to be added to the receiving outfits of Los Angeles, Calif., police radio cars, if the necessary special permission can be obtained from the Federal Radio Commission. They will enable police cars to flash an immediate call for an ambulance if one is needed. A compact transmitter that takes up no more room than an automobile storage battery has been perfected for the purpose by J. G. Rosso, radio supervisor of the Los Angeles police department, who is shown at left with his new set.

STRANGE HUMAN FIGURES TRACED IN DESERT SAND

SEEKING a suitable spot for a forced landing, a pilot recently came upon giant figures of men and animals on the desert near Blythe, Calif. Scientists are reported to be completely mystified by the discovery, and have enlisted the aid of the Army Air Corps to photograph the strange designs from the air. One of the pictures, reproduced above, shows a human figure ninety-five feet long. Ground exploration showed the figures had been made by scraping away the thick surface layer of brown pebbles, exposing the soil beneath.

WALKING FISH FOUND IN GREENLAND

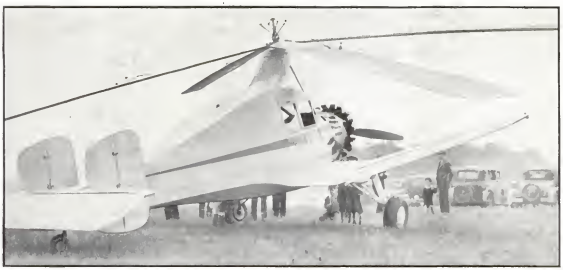
A FOUR-LEGGED walking fish, discovered recently near a Greenland fjord by Dr. Lauge Koch, veteran Danish explorer, is believed the long-sought missing link through which, ages ago, fish evolved into frogs and other amphibians. Thousands of petrified specimens of the queer creature were found in one spot, apparently slain by some prehistoric catastrophe. Those brought back are reported so valuable that, if sold to museums, they would pay the cost of the ninety-man expedition for three years. Scientifically Dr. Koch classifies his walking fish as a member of the family of "Stegocephali," an extinct order of salamander-like amphibians, of which he believes it the patriarch. At the date he ascribes to its existence, it might easily have been a transition stage in evolution between fishes and amphibians, which in turn evolved into reptiles, mammals, and man, as illustrated in the sketches above.

Other members of the walking fish family have been discovered before. A restoration of one is illustrated. While none of them lived sufficiently early to be a possible missing link, the new fish is reported to resemble them.

TAIL LIGHT ON THE HEEL

PEDESTRIANS may walk in safety along an unlit road at night, with a new tail light strapped to one heel. Under the rays of an automobile headlight, its reflector flashes a warning red signal to the driver.

Biggest Autogiro Has Four-Place Cabin



Biggest autogiro yet built. It has a four-place cabin and is designed for use in commercial transport work as well as for private flying. Tests proved its airworthiness

AUTOGIROS are growing up and taking on new responsibilities. Newest and biggest of the windmill plane models so far built is a four-place cabin model suitable for commercial transport use, and also for private flying. Twin rudders and a 400-horsepower motor are innovations appropriate to the larger size. While the latest machine is an experimental model, it is expected that its success in tests at Pitcairn Field, near Philadelphia, Pa., will be followed by quantity production. An odd appearance is given the craft by the high, arched roof of the cabin.

TINY ONE-MAN PLANE MAY BE AIR FLIVVER

MORE like a motorcycle side car than a fuselage is the body of a new baby plane recently exhibited in Germany. A radiator at the front cools the motor, which is concealed just behind it, and which drives the propeller through a vertical drive shaft and a system of gears. The control surfaces of the tail are mounted at the end of a long outrigger. According to the designer, machines of this type could be sold to prospective users in the form of complete sets of parts, to be assembled at home. Only the motor, propeller, and fuel tank would be shipped complete. Thus anyone could purchase a flivver plane at a minimum of expense, suppying the labor to assemble the parts himself. In this way the original cost of the machine could be materially reduced. The designer says some scheme like this will eventually fill the air with planes.

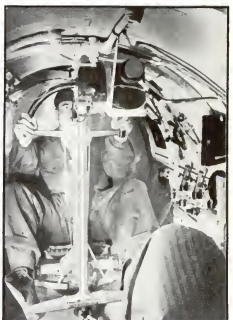
This tiny, knock-down German plane is expected to be the future flivver of the air

TWIN DISKS SHARPEN SAFETY RAZOR BLADE

TWIN disks of an abrasive compound, housed in a metal container resembling a small vanity case, provide the shaver with a new device for sharpening the blade of his safety razor. Projecting from one of the disks are two lugs spaced to accommodate the holes or slots of the blade and to hold it in position to be honed when the case is sbut and a crank turned. According to the manufacturer, a few turns sbarpen the blade.

PILOTS FACE EACH OTHER IN STRATOSPHERE PLANE

WHAT the inside of a stratosphere plane looks like is shown in the picture at the right. It is the first view to reach tbis country sbowing the interior of a Farman plane recently tested near Paris, designed to fly at high speed through the rarefied atmosphere nine miles above the earth (P.S.M., Oct., '32, p. 13). Two pilots sit facing each other in the barrel-sbaped cabin, which is sealed airtight to protect them from the physiological effects of reduced air pressure at great heigbts. They will fly the machine blind, depending upon instruments alone to guide them except in taking off and landing. When tbe time comes for descent, the pilot facing the camera, in the picture, climbs into the open through a circular trapdoor just above his head. Sitting on top of the plane, he lands it by means of extended control levers. Latest plans call for an attempt at a nine-bour flight from Berlin to New York with the new plane flying at a high altitude.

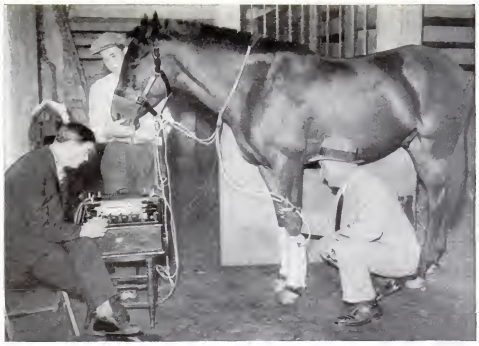


Interior view of the airtight cabin of the stratosphere plane recently tested in France

ESCALATOR IN GARAGE SPEEDS CAR SERVICE

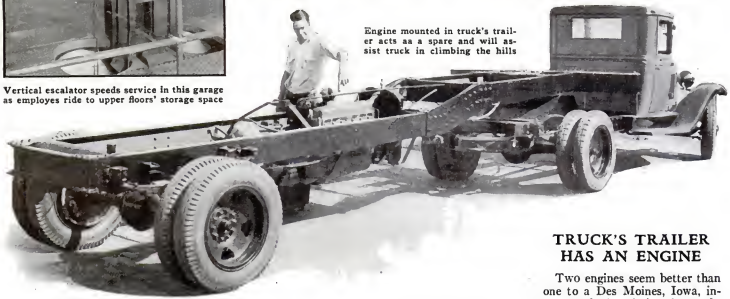
WORKERS in a San Francisco, Calif., garage, with a 1,000-car capacity, can deliver a customer's automobile from the eighth floor to the sidewalk in forty seconds. This is made possible by a vertical escalator and a long ramp down which cars are driven. Each worker, going for a car, steps on a tiny platform attached to an endless belt and rides straight up. To descend, he steps on the other side of the escalator and rides down. Electrical motors keep the escalator running constantly.

Vertical escalator speeds service in this garage as employes ride to upper floors' storage space



RACE HORSES NOW GET ELECTRIC CURE

WILL electricity make a race horse run faster? So believes Dr. Robert L. Humphrey, Washington, D. C., veterinarian, who, at the Washington Riding and Hunt Club, is applying an electric cure for bowed tendons and other ailments to which thoroughbreds are subject. He employs diathermy apparatus resembling those used for human patients, which provides an internal heating effect to speed the healing of tissues in a humane and painless way. The photograph shows Dr. Humphrey treating one of his patients, while an assistant manipulates the electrical apparatus.



Engine mounted in truck's trailer acts as a spare and will assist truck in climbing the hills

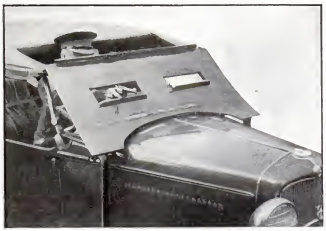
TRUCK'S TRAILER HAS AN ENGINE

Two engines seem better than one to a Des Moines, Iowa, inventor who has designed a truck-and-trailer combination with an extra motor. The booster engine is mounted on the chassis of the trailer, complete with its own gasoline tank, radiator, clutch, and transmission. To set it in motion, the truck driver pulls out a button on the truck's dashboard. He has two gear-shift levers, one for the truck and one for the trailer.

According to the inventor, the booster engine will help a heavily-loaded truck over a hill. It will also propel the truck in case of accident to the truck's engine. Since the trailer's power plant is free-wheeling, there is no interference with the regular drive.

BULLET BOUNCER ON CAR SAVES POLICE FROM THUGS

BULLET bouncers are now in use on cars of the San Francisco, Calif., police department to protect members of radio patrol crews from the gunfire of thugs. The contrivances are sheets of quarter-inch-thick steel plate, equipped with shuttered windows and hinged to the top of the windshield frame. Normally the bullet bouncer lies flat upon the top of the car, but it is lowered in front of the windshield when gangster bullets begin to whiz. The windshield folds out of the way, and patrolmen fire through the narrow windows. They may also peep through a hole in the car top.



PHONOGRAPH AND LOUDSPEAKER REPLACE ARMY'S BAND

Phonograph music, amplified by loudspeakers on top of the car, replaced the regular band when the Danish soldiers went on a cross-country march

WILL canned music inspire future warriors? Veteran army bandmasters in Denmark were taken aback when a lumbering sound truck recently took the place of a regular band and led a detachment of Danish soldiers on a cross-country march. Martial airs played upon a phonograph were amplified and projected to front and rear by horns atop the truck. Lively discussion was stirred up two years ago in this country when the United States Army became interested in mechanical bands to replace musicians. A sound truck for this purpose was designed, built, and offered for test by the Radio Corporation of America (P.S.M., Aug., '30, p. 48). Its volume equalled that of two Army bands and the quality of music was called as good as the average in the service. To date, however, no definite move to adopt the mechanical substitute for bandsmen has been made public.

CABLE CAR TAKES TOURISTS UP 6,000-FOOT MOUNTAIN

LATEST in vehicles for aerial sightseeing is an all-aluminum car put in service at Engelberg, Switzerland. Its fifteen passengers are treated to a breath-taking view of Alpine scenery during a 6,000-foot ascent on cables. The precipitous climb is made practicable by the lightness of the car's metal construction, which minimizes the power required to operate the hauling cable to which the cabin-like car is securely attached.

ELECTRIC EYE WORKS MAGIC FOUNT

A PUZZLE to the uninitiated are the "magic fountains" that have appeared in several cities. Water automatically spouts from one of these fountains when a person bends over to get a drink, and stops of its own accord when the user withdraws, all without manipulation of handles or valves. The secret of the fountain is a light-sensitive electric eye, so mounted that anyone who stoops for a drink will interrupt a beam of light focused upon the cell. His shadow operates an electric relay that starts the water flowing.

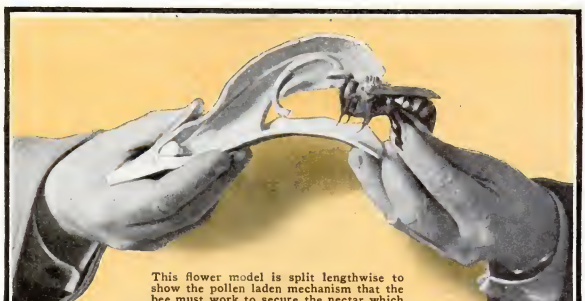
DIVING ARMY PLANES BOMB TARGET

Diving Army plane drops bombs at target in the circle

DIVING out of the sky, wing-clipped pursuit planes fell at nearly 300 miles an hour in bombing practice at Langley Field, Virginia, recently. In rapid succession, they dived, stung, swooped away. Each time, the ground within the white circle marking the target was torn up by the high-explosive shells they released. These maneuvers are part of an annual competition for army airmen which also includes machine gun contests in which pilots, trained in the manner explained on page forty of this issue, have an opportunity to demonstrate their skill.

By Gaylord Johnson

Whose Skill Developed a New Way to Reveal One of Nature's Mysteries



This flower model is split lengthwise to show the pollen laden mechanism that the bee must work to secure the nectar which lies hidden at the very base of the blossom

Suspended by wires, a model bee is held in place above a model flower while Gaylord Johnson photographs it for his series of movie pictures that show exactly how plants are fertilized

Movie Models show HOW BEE

BLOSSOMS are, as everyone knows, the restaurants or groceries of bees—and food is not furnished free, any more than it is in human shops.

The bee pays by becoming a messenger; she carries away a little of the vital pollen dust from the flower's stamens. It adheres to her hairy coat and tongue.

Upon the sticky pistil of the next flower visited, some of this yellow dust is rubbed off, thus aiding in the cross-fertilization of the second plant's seeds.

It is plain that the bee secures her supplies of nectar in return for performing this messenger service. To make sure that it is properly carried out, the flower hides its drop of nectar far behind the pollen-laden stamens. The bee must pass them and receive her pollen dust for delivery at the next flower before securing the honey.

Everybody understands this general plan and its operation, but almost everyone is ignorant of the many amazingly ingenious mechanical devices flowers have invented to force their favorite insects into close cooperation in the messenger work.

In order to make some of the blossom-mechanisms plain, the writer hit upon the idea of reproducing these devices, and the bee itself, as workable scale models.

The models were made from a self-setting modelling clay that becomes as hard as stone when dry. After drying overnight, the models were painted in natural colors.

The bee's legs were made from pipe-cleaners, and its wings from bristol board. The short stiff hair was represented by thin grass stems stuck into the wet clay and then clipped off close to the body. The long flexible tongue was fashioned from a narrow strip of cloth adhesive tape. When painted in tones of black and white enamel, the giant three-inch bee looked surprisingly realistic as the photographs show.

The first flower model was made to represent a single blossom of the sage which is so often found in old-fashioned gardens. The bloom is shown split lengthwise through the middle to reveal the mechanism the bee must operate in order to secure a drink of the nectar stored deep down in the flower's heart behind the stamen.

When the models of bee and flower were brought together and made to go through the various stages of the visit, the mechanical ingenuity of the lever mechanism worked by the bee became strikingly apparent.

All the acts required of the bee for the sage flower's fertilization are revealed in the sequence of pictures of the movie model shown at the top of page 25.

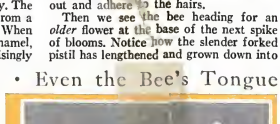
In the first picture, the bee is approaching one of the more recently opened blossoms. These are found near the buds at the top of the flower stalk.

In the next picture, the pressure of the bee's head upon the lower end of the curved lever has brought the oval pollen box down over the bee's back and wings.

In picture 3, the bee's continued movement has clapped the box, full to bursting, upon her back. Many grains are spilled out and adhere to the hairs.

Then we see the bee heading for an *older* flower at the base of the next spike of blooms. Notice how the slender forked pistil has lengthened and grown down into

Even the Bee's Tongue

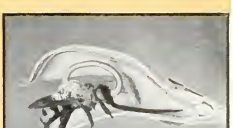


1 Two flower forms of Quaker Lady. Left, flower with short pistil and high pollen boxes. At right, flower with low pollen boxes and long pistil

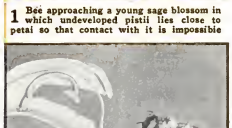
Bee Forced to Work Strange Trap to Get Nectar

1 Bee approaching a young sage blossom in which undeveloped pistil lies close to petal so that contact with it is impossible

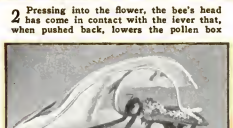
2 Pressing into the flower, the bee's head has come in contact with the lever that, when pushed back, lowers the pollen box



3 Forcing its way in to reach the nectar. Note how the movement of the lever has lowered pollen box until it touches bee's back



4 Covered with pollen dust, the bee approaches an older sage blossom in which the developed pistil hangs across the entrance



5 Note that in order to reach the honey, the bee is forced to pass beneath pistil thus covering it with the pollen dust

6 With some of the pollen still clinging to its back, the bee leaves the flower it has just fertilized and continues the cycle

EARNS ITS HONEY·

the position needed to wipe the dust from the visitor's fur as she enters.

In the next view this wiping is taking place. After securing her nectar, the bee will depart, as shown in the last picture, leaving a few pollen grains sticking to the forked stigma of the long pistil. These grains there travel the whole length of this slender curved filament to the ovary of the flower, where they fertilize the seeds it contains.

Once more the bee may enter a younger, higher-up flower on the stalk. Again the lever will come down and powder her back and so the cycle continues all day long. Every morning, new flowers open from the buds at the top of the stalk, and every night the fertilized older flowers at its base wither and droop, after their clever mechanism has accomplished its purpose of insuring fertilization.

In the pictures of the Quaker Lady at the bottom of pages 24 and 25, another astonishingly simple invention is shown in operation.

First are the two different forms of the flowers. All the blossoms on one plant will be built on the pattern of the model at the left, with a *short*, forked pistil and *high*-set pollen boxes. Another plant, perhaps growing some distance away, will be found arranged on the plan of the model at the right, with *low*-set pollen boxes and a *long* pistil. Both models show the flowers split in two lengthwise.

In the next picture, the bee alights upon and has her tongue powdered by a flower with the *high*-set pollen pads.

Must Carry Pollen from Flower to Flower·

2 Bee on Quaker Lady flower with high pollen pads gets pollen on its tongue

3 With its load of pollen, the bee seeks another flower on endless honey quest

4 Finding, by chance, a flower of the second form, its tongue deposits pollen

Then she is seen in transit to a flower on a plant of the other type, which she reaches and probes in the last picture. You will see here how the pollen, added by the *high* boxes, is rubbed off upon the high pistil, while more is added lower down by the low boxes of this flower.

Another surprising example of nature's ingenuity is found in the flowers of the barberry shrub which hang down in long clusters. The young flowers open as little golden bells just above the buds. Higher up on the cluster are the older flowers. In the young flowers, the pistil stands alone, with the six stamens resting in the hollows of the surrounding petals. In the lower end of each stamen is a pollen box, closed with two ear-like lids. In the old flowers, these lids are open. When a bee alights on one of the old flowers and probes with its tongue for nectar, the pollen boxes suddenly slap down toward the pistil and pollen is spilled all over the bee's tongue and face. If the bee then goes to a young flower, it will inevitably rub off some of the pollen on the toothed edge of the disk at the end of the pistil and thus fertilize its seed.

Flower mechanisms are almost infinite in variety, but the main ones can be grouped under about twenty-five types. Those described are among the most interesting and ingenious that the writer has so far been able to discover and investigate. Simple field observations on the part of the reader will reveal to him astonishing flower mechanisms, perfectly adapted to aid the plant in perpetuating its species.

Tear Gas Gun on Wrist Is Fired by Finger Ring Trigger

Picture, below, illustrates the manner in which tear gas gun can be used merely by raising the arm and bending the wrist

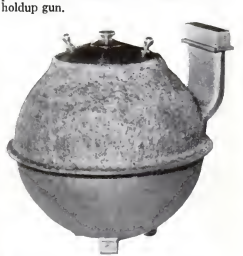
Tear gas gun on wrist with leather band to protect skin and catgut string running from ring to trigger to discharge the gun

SHOT by a trigger worn as a finger ring, a wrist gun that belches out clouds of tear gas has been designed for the protection of clerks, cashiers and payroll messengers. The little gun, with its muzzle pointing forward, is strapped to the wrist where it is hidden by the coat sleeve. A thread of flesh-colored catgut, invisible at a glance, connects a ring worn on the second finger with a trip that releases the gas. The hand can be moved about freely, but when the wrist is bent suddenly at a sharp angle, the gas is discharged. To protect the wearer's arm from being burned by the gas, the skin under the muzzle of the gun is covered by a wide band of leather. A retired Chicago, Ill., policeman is the inventor of the new anti-holdup gun.

VACUUM GLASS BRICKS CUT HEAT LOSS

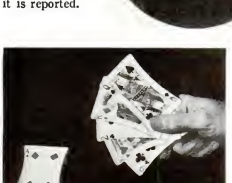
WINDOWS made of glass bricks form a striking feature of the new Long Island Park Commission building, recently completed at Sunken Meadow, N. Y. Made of unusually clear and strong glass, the bricks have vacuum centers, ninety-two percent of the air being exhausted from the interior before they are sealed up. This feature makes them practically sound-proof and reduces the cost of heating the building, according to the manufacturer, from thirty to sixty percent. In the average buildings, tests are said to have shown, more than half the heat lost passes out through the window panes. The use of the new glass vacuum bricks will cut this to practically nothing, it is reported.

Windows in this building are made of glass bricks, with vacuum center. In circle, pencil indicates point at which brick was sealed to maintain the vacuum



BOMB-LIKE SMALL SAFE IS SET IN CONCRETE

LATEST protection for valuables in the home, store, or office is a safe that looks like a bomb. Made of special metal, developed after several years of research, the spherical safe, according to its makers, cannot be broken or drilled through. It is buried in the concrete of a floor or wall with the top, containing the combination lock, protruding above the cement. V-shaped legs admit steel reenforcing bars which are also embedded in the concrete



NARROW BRIDGE CARDS HAVE CONCAVE EDGES

PLAYING cards of the narrow bridge size, with concave edges, have made their appearance. The new shape, it is said, makes it easier to hold and play a hand of thirteen cards. The unusual cards can be shuffled and dealt, according to the maker, as readily as an ordinary pack.

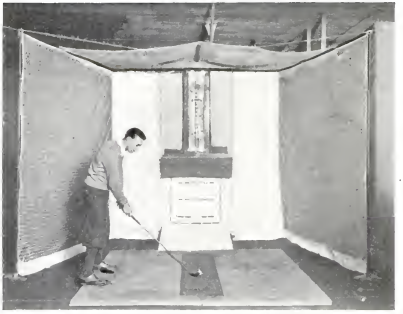
TAIL LIGHT SHINES ACROSS CAR

AN AUTOMOBILE tail light, resembling a neon tube, has been developed by an Indianapolis, Ind., inventor. The streak of red light, running across the car is easily seen from any position in the rear and it also outlines the width of the vehicle. This is especially desirable in the case of unusually wide buses. The light is tubular in shape and from fifty-four to ninety inches in length. Two standard tail light bulbs, which are placed inside the tube, supply the illumination.

Auto tail light, running across entire rear of car, shows a long red streak which is easily seen. Close-up, above, outlines the streak of light which comes from two concealed tail light bulbs

Realistic Indoor Golf Game Gives Chance to Use All Clubs

GOLF matches may be played indoors, using the clubs that would be employed outdoors, with a new machine that will fit in a twelve by fourteen-foot room or a one-car garage. When a ball is driven from a mat against a canvas backdrop, the distance the ball would have gone on a regular course is registered upon a chart. Unseen mechanism, actuated by the impact on the canvas, propels a small ball upward across the chart and stops it at the exact point to indicate the yardage of the player's shot. Four such individual indicators are provided, allowing four persons to play. When each has noted the position of his ball after his drive, he selects the proper club to play his second shot and makes the stroke exactly as on an outdoor course. Again the ball-shaped indicator moves upward to show where the ball would land. At the conclusion of each hole, a few turns of the roller-mounted chart expose a fresh section representing a new hole. This may be regulated so that the exact distances and conditions of any desired course can be reproduced at will. Experts who have tried the device say that all shots, from the longest to the shortest, can be played with assurance that the precise distance the ball would travel if played on a real course will be registered on the chart. The apparatus is so compact that it is suitable, not only for golf clubs or schools, but for practice in the home as well.



Yardage made with indoor golf shot appears on scale shown in enlarged drawing at right

NEW BUS HAS ENGINE IN ITS SIDE

DESIGNED to provide maximum space and comfort for passengers, a new type of motor bus, with the engine concealed in the right side of the body recently made its appearance on the streets of London, England. The innovation allows the full length of the coach to be utilized for carrying passengers. In addition, the new position of the motor makes it easily accessible for repairs or adjustment. In the type at present in use, the passengers enter and leave the coach through a rear door.

Two views of the new London bus that has its engine set in the side so the entire length of the car can be used for passengers. Also, engine is accessible for repairs

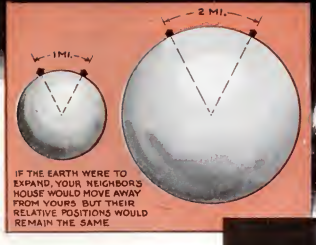
WORDS APPEAR ON SCREEN AS FAST AS THEY ARE WRITTEN

AS THEY are written, words are thrown on a screen by a new projection apparatus developed in Germany. It enables a lecturer to illustrate points by drawings or writing without turning his back to his audience. The writing is done on an illuminated sheet of cellophane at the center of a horizontal desk. Light, directed upward from underneath the sheet, passes through an enlarging lens to a tilted mirror that casts the magnified image on a wall screen.

A turn of a knob moves the transparent strip to provide clean space for additional writing. The strip may also be rolled back at any time to diagrams previously used. To save time during a lecture, especially difficult diagrams can be drawn on the sheet before the meeting and moved into place when desired. Lantern slides can also be thrown on the screen by laying them over the illuminated space. Notes can be made to appear on the slides, without damaging them, by writing on the cellophane, over which they are placed.

Blast of Giant Atom

By
Donald H. Menzel
Harvard Observatory



OUT of a single, bursting atom came all the suns and planets of our universe!

That is the sensational theory advanced by the famous Abbe G. Lemaître, Belgian mathematician. It has aroused the interest of astronomers throughout the world because, startling as the hypothesis is, it explains many observed and puzzling facts.

According to Lemaître's theory, all the matter in the universe was once packed within a single, gigantic atom, which, until ten thousand millions years ago, lay dormant. Then, like a sky-rocket touched off on the Fourth of July after having remained quietly for months on a store shelf, the atom burst, its far-flung fragments forming the stars of which our universe is built.

The manner in which certain kinds of atoms explode can be seen easily in a simple experiment. If you take a radium watch into a dark room and look at the dial through a magnifying glass, you see what appears to be a brilliant display of miscroscopic fireworks. While you are looking at the showering sparks, remember that each flash comes from an exploding atom. In each spark, you see a small-scale reproduction of the new theory of the birth of our universe.

On the average, every radium atom lies dormant for about 1,730 years, after which time it explodes and shoots out particles in much the same way as the parent atom gave birth to the stars.

The new theory provides an explanation for one of the most extraordinary scientific facts ever discovered. Our telescopes show us that there are, out in space, millions of disk-shaped star-clusters known as extra-galactic nebulae. It is generally believed that our Milky Way is such an object and that our sun is but one of billions of stars that go to form it. One of the larger members of the class, the spiral nebula in Canes Venatici, is so far away that light from it takes almost a million years to reach us. Furthermore, observations indicate that every second it moves still farther away from our solar system by some 170 miles.

For every large, bright nebula there are thousands of small, faint, and presumably much more distant ones. Surveys out to one hundred million light years are in progress. The extraordinary feature referred to above is not, however, the magnitude of the figures, but the discovery that the more distant the nebula the more rapid is its motion *in a direction away from us!* The present record-holder is a tiny nebula whose cosmic speedometer registers in excess of twelve thousand miles a second!

Why, astronomers have asked, are the


YOU CAN SEE AN ATOM BOMBARDMENT IF YOU LOOK AT THE NUMERALS ON A RADIUM DIAL WATCH UNDER A MAGNIFYING GLASS IN THE DARK

Created Our Universe

WITH THIS GIANT MAGNET UNIVERSITY OF CALIFORNIA SCIENTISTS HOPE TO REVEAL THE SECRETS OF THE TINY ATOMS THAT COMPOSE ALL MATTER IN THE UNIVERSE

THIS DIAGRAM OF THE GROWTH OF A NEBULA IN AN EXPANDING UNIVERSE SHOWS HOW DISTANT STARS (BLACK DOTS) APPARENTLY ARE RUNNING AWAY FROM US DUE TO EXPANSION OF SPACE. NOTE THAT STARS OCCUPY SAME RELATIVE POSITIONS IN EACH STEP

Drawings by B. G. SEIELSTAD

more distant objects moving faster? Why does the motion always seem to be *away* from us? If the motion is one of simple expansion, why should we find ourselves so nearly at the center, looking outward?

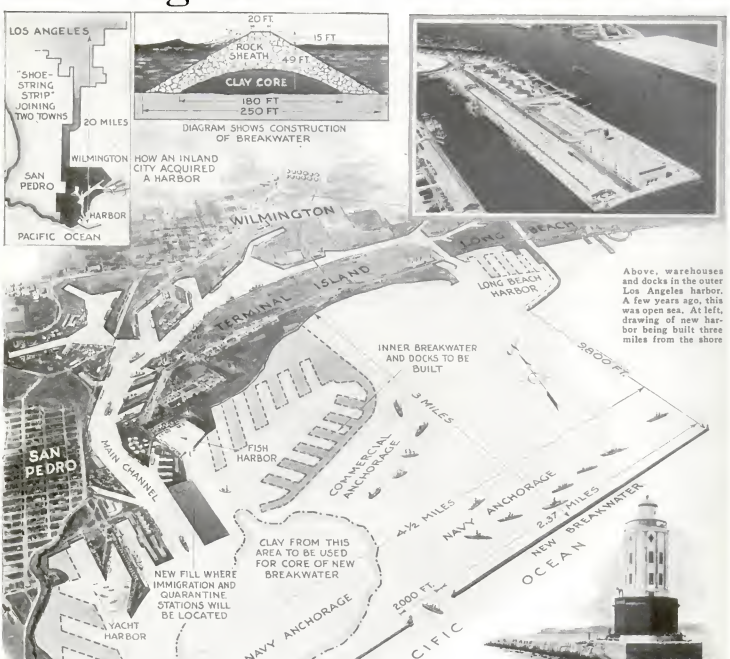
Exponents of the theory of relativity have been inclined to accept the view that the universe is actually expanding. But the apparent central position of our earth, they believe, is an illusion, that may be illustrated by an analogy. Suppose that, during the night, the earth were to double in size, while everything upon its surface were to remain unchanged. In the morning you would awake to find that your neighbor, who previously lived only fifty feet away, was now one hundred feet away. The Smiths, who lived a mile away, would be two miles away. In every direction, there would be an apparent withdrawal, which would be greater for more distant objects. Everybody would be similarly affected and each would believe himself to be the center away from which the other objects had moved.

The case of the universe is analogous, except that the expansion, being of a three-dimensional volume, cannot be visualized. The phenomena are, however, comparable. The nebulae are not running away from us. Their recession is due to expansion of space. This may, perhaps, seem to be quibbling over terms, since it amounts to the same thing in the end. Nevertheless, the distinction is worth keeping. According to the relativity theory, there is a difference between the running away of the nebulae and expansion of the medium in which they are imbedded.

The hypothesis, however, is not without difficulties. The expansion is so rapid that, going back only ten thousand million years, we find the stars more closely packed than automobiles are in Times Square in New York City at the theater hour. Ten thousand million years may seem too long to cause us to worry about parking places for prehistoric stars. Nevertheless, geologists tell us that the earth is at least a billion years old and we have come to regard this period as but a minute fraction of the entire lifetime of the universe. Hence the difficulty!

In a sense, this belief is a heritage from the nineteenth century. The great French astronomer, Pierre de Laplace, suggested that the sun and planets might have condensed from a *(Continued on page 105)*

Build Big Harbor Three Miles at Sea



Above, warehouses and docks in the outer Los Angeles harbor. A few years ago, this was open sea. At left, drawing of new harbor being built three miles from the shore

LARGE enough to contain several dozen docks and provide anchorage for the Pacific and Atlantic fleets and fifty commercial vessels, a harbor is being built three miles at sea off the southern California coast. It will become part of the outer Los Angeles harbor and a new breakwater, containing enough clay and rock to build a mound 472 feet on each side, will make possible this engineering feat. During the next six years, dredges will scoop clay from the Pacific and lighters will carry thousands of tons of rock to the new breakwater. Thousands of scow loads of these materials will be dumped along the line of the breakwater, 2.37 miles long, until, at a cost of $7,000,000, a ten-square-mile section of the sea has been fenced off. Three earth and rock breakwaters will form the outer rim of the harbor. Of these, two are in place. The first, 2.11 miles long, extends into the sea south and east from the west edge of the harbor. A second juts a mile south and west from Long Beach. The third will continue along the line of the first, leaving an opening 2,000 feet wide through which ships can enter the inner harbor.

Upper view, lighthouse at end of the present Los Angeles harbor breakwater. Above, air view of dredges filling in site for warehouses

Pontoon Boat Aims at 150-Mile Speed

Strange Craft Has Tractor Propeller Under Its Cockpit and Draws Inch of Water

Thomas A. E. Lake demonstrates his pontoon speedboat. Note wake, above, which shows boat is making turn at high speed

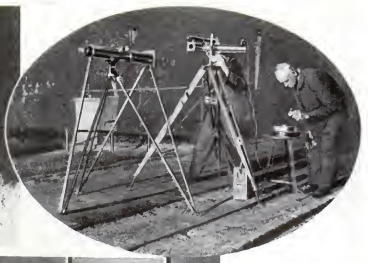
SAFE water travel, at speeds that only the most daring race pilots now attempt, is brought within reach of everyone by a radically new type of water craft. When suitable motors are installed, the inventor expects it to shatter all records and attain 150 miles an hour. Despite its swiftness, the airplane-shaped boat demonstrated extraordinary stability in its first trials on Long Island Sound, N. Y., the other day. It amazed marine experts among the spectators by turning around in its own length, at high speed, without upsetting.

The inventor, Thomas A. E. Lake, son of Simon Lake, famous builder of submarines, predicts that his superspeedboat will banish risk and discomfort from two-mile-a-minute water travel. It skims the surface on three pontoons equipped with shock-absorbers drawing only an inch of water when in motion. The wide span of the forward pair of pontoons accounts for the craft's stability. When the helmsman turns the steering wheel, the rear pontoon pivots to serve as a rudder. Meanwhile, through interlocking levers, the forward pontoons are automatically banked to aid in rounding a turn. A tractor-type propeller, beneath the center of the twenty-one-foot craft, pulls it along. The whole boat rotates about this center when a turn is made. A thirty-five horsepower outboard motor was used in the experimental trials, and installed just in front of the pilot's seat so the hinged propeller shaft could be drawn up into the cockpit.

SIXTY-FOOT BUS TO CARRY VISITORS AT WORLD'S FAIR

SIXTY feet long, but able to turn in its own length, is a bus designed to carry visitors about the grounds at the Chicago World's Fair, next year. Of a semi-trailer type, it will accommodate fifty seated passengers and forty-five standing. A fleet of sixty of the machines has been ordered at a cost of $300,000. Two of them are already in use at the fair grounds and another will soon start on a tour of the country, carrying a miniature reproduction of the World's Fair as it will appear when ready to be opened to the public. The tour will be for the purpose of advertising the big attraction.

Giant Light and New Apparatus Used in Study of Coast Beacons



SHOOTING across eight miles of darkened water each night, a 75,000,000-candle-power beam is enabling German scientists to assemble valuable new data about lighthouses. Not far from Berlin, on the Mueggel Lake, the government has established an experimental lighthouse where Germany's strongest beacons are being tested before being installed for active duty along the coast. On the opposite shore of the lake, eight miles away, an elaborate array of scientific apparatus is assembled to record the amount of light reaching them under varying atmospheric conditions. These exhaustive records are expected to lead to future improvements in the warning lights erected at dangerous points along the coast.

At far left, view of experimental lighthouse set up on Lake Mueggel near Berlin. Its 75,000,000-candle-power light is flashed across the lake to the instruments, in the oval, which gage its power

At left, close-up of the signal beacon whose penetrating power, under varying weather conditions, is being studied to assist in the designing of new and more efficient lighthouses

QUIET ELEPHANT USES LITTLE ENERGY

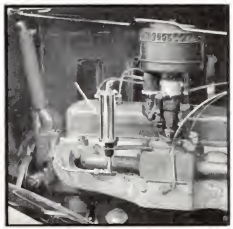
How much energy does it take to keep an elephant alive? Dr. Samuel Brody, of the University of Missouri, Columbia, Mo., recently made tests to find out. By means of a huge spirometer, an instrument that records the amount and rate of oxygen consumption, he discovered that an 8,000-pound circus elephant, when resting, uses only two times the amount of energy used by a horse. Dr. Brody has discovered that the larger the animal, the smaller are its energy needs, when resting.

FIRE ALARM BOX PUTS HANDCUFF ON USER

A NEW fire alarm station, recently demonstrated at St. Louis, Mo., automatically snaps a handcuff on the wrist of one who turns the key. To sound the alarm, it is necessary to insert the arm in a metal sleeve beneath the box. As the signal is sent in, this sleeve clamps to the wrist of the sender. Although he cannot remove the sleeve, the person who sounds the alarm is free to return to the scene of the fire. When the firemen arrive, they remove the sleeve by means of a special key.

MILES PER GALLON OF GAS SHOWN ON GAGE

How many miles are you getting to the gallon? A small gage attached to the steering post of a car, illustrated above, will answer that question at any moment during a drive, according to its manufacturer. The meter employs a small, upright cylinder through which the fuel passes on its way to the carburetor. The pressure of the flowing gasoline causes a piston in the cylinder to rise. The greater the flow, the greater the pressure and consequently the higher the piston moves. Electrical contacts, made by changes in the position of the piston, move the steering-post gage needle along a dial numbered from one to five. The speed indicated on the speedometer divided by the number indicated on the gasoline-flow gage will give the motor performance in miles per gallon. For example, if the speedometer reads "30" and the flow meter "1," you are getting thirty miles per gallon. The gage is foolproof, the maker claims, and is accurate to a fraction of a gallon in its measuring of amount of gas used.



Arrow points to cylinder through which gas passes on way to carburetor in miles-per-gallon gage

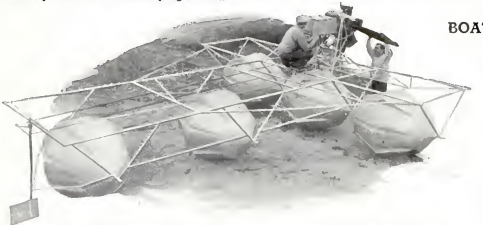
STEEL STRIPS FORM SUSPENSION ROOF

Above, hoisting 140-foot steel strip to elevator roof. At top, note roof sags like bridge cables

Below, operators lap welding the long strips of steel. Men hoist themselves with a sheave block

SUSPENSION roofs, just erected upon four New York State grain elevators at Albany, N. Y., present an innovation in building methods. Dispensing with columns and trusses, which would have reduced the available storage space, they are entirely self-supporting. The roofs were formed from strips of steel four feet wide, welded together in 140-foot sections. Each section in turn was raised into place with the aid of cables and a hoisting engine, and bolted fast at top and bottom. When all the strips were installed, welders joined the overlapping edges to form a solid roof of steel, that sags in the shape of the cables supporting a suspension bridge but which is said to be able to sustain a greater weight than will fall on it.

BOAT RUNS ON ROLLING DRUMS



Five freely revolving steel drums support this boat on the surface of the water

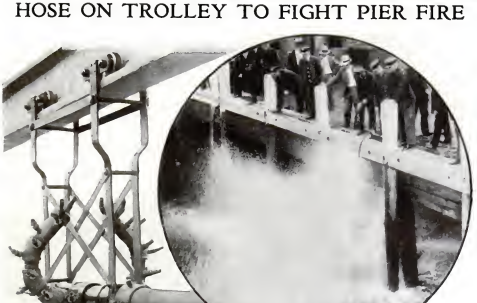
A BOAT that runs along the surface of the water on drums was given a trial recently on the Hackensack River, near Newark, N. J. Five specially-designed white steel drums, having indentations like the treads on tires to increase their grip upon the water, support the craft. The free-rolling drums reduce the resistance of the water and are expected to permit high speeds with low power. An airplane engine and propeller drive the boat, which can be run up on the shore. During the experimental runs, the body, which will accommodate several passengers, was not attached to the framework.

CHILDREN RIDE TINY GAS-ELECTRIC TRAIN

COMPLETE in every detail, a miniature gas-electric train that carries passengers, has been built by a British railroad man at Sherringham, England. The tiny coaches, made to scale, reproduce large ones used on the railway for which their builder works. A small gasoline engine runs the generator that supplies electric current. A circular track accommodates the model coaches in which children ride as passengers. Three months were spent in building the system.

Model gas-electric train, complete in all details, runs on a circular track and has coaches large enough for children to ride in

HOSE ON TROLLEY TO FIGHT PIER FIRE



Fire hose with twenty-six nozzles, runs on a monorail. In circle, the apparatus in action

PIER fires are now fought with a hose that runs on a trolley and a nozzle that shoots out twenty-six streams of water under high pressure. Hitherto fires beneath steamship piers, such as recently destroyed the Cunard Line pier in New York City, have been almost impossible to stop once they got under way. The new apparatus, recently demonstrated before New York fire officials, consists of a monorail attached under the floor of the pier and carrying, on a wheeled supporting framework, a curious multiple nozzle which looks like a twisted tree root and projects its twenty-six streams of water upward and to the rear. The pressure of the water drives the mechanism slowly forward, the hose playing out behind. Each nozzle will lay down a barrage of water forty feet wide which will concentrate on the blaze at the point where it is hardest to attack with ordinary equipment. A complete installation would include a battery of the monorail nozzles running from one side of the pier to the other at regular intervals to reach all parts of the pier.

CAR'S ALCOHOL CAUGHT; PUT BACK IN RADIATOR

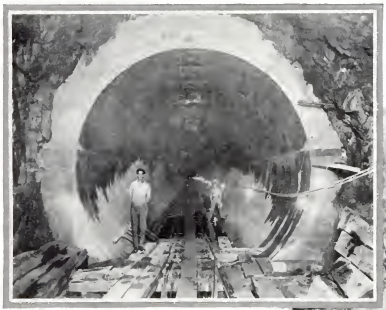
A SIMPLE apparatus has been designed to prevent loss of alcohol from automobile radiators during winter driving. It consists of a condenser tank attached to the dashboard under the hood and a long rubber tube, one end attached to the bottom of the tank and the other slipped over the lower end of the radiator overflow pipe. Alcohol, having a lower boiling point than water, turns to vapor first. As the alcohol boils off during a long run, it condenses in the tube and is carried into the condenser tank. After the car has stopped and the motor cools off, the alcohol vapor above the solution in the radiator becomes liquid again. This produces a vacuum, and air pressure forces the alcohol in the condenser tank back up the pipe into the radiator where it can be used over and over with little appreciable loss.

✓ GROW 5,000 PLANTS IN SIX-FOOT HOTBED

A FIVE-DOLLAR electric hotbed, with eight twenty-five-watt suns supplying heat and light to germinating plants, has produced interesting results in the Westinghouse laboratories, at East Pittsburgh, Pa. Five thousand plants, representing fifty different varieties of common garden flowers and vegetables, were produced in the six-by-four-foot bed at an average cost for electrical energy of less than one-thirtieth of a cent each. This is about the same as the cost of delivered manure, ordinarily used in hotbeds, but the electric method has the important advantage of automatically maintaining an even temperature as it has a thermostat control. During tests, last spring, the outside temperature dropped as low as sixteen degrees F., but the eight lamps kept the interior of the bed at fifty degrees. On a miniature scale, they duplicate the effect of the sun, by providing heat and light.

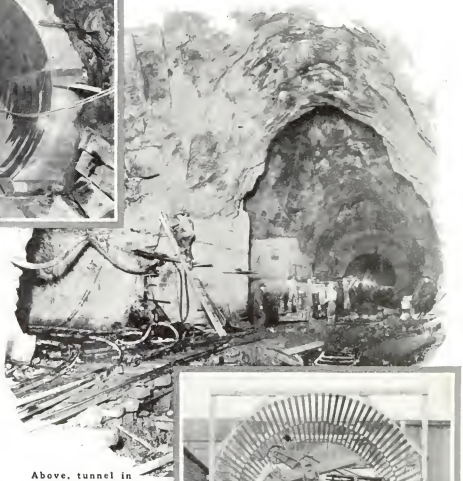
In this six-by-four foot hotbed, 5,000 plants were grown at a cost, for electric heat, of one-thirtieth a cent per plant

World's Longest Water Tunnel



Twenty miles long and over fourteen feet in diameter, the world's biggeat water tunnel, a completed section of which is shown at the left, is nearing completion and when finished will help carry a billion gallons of water to New York City homes and factories every day

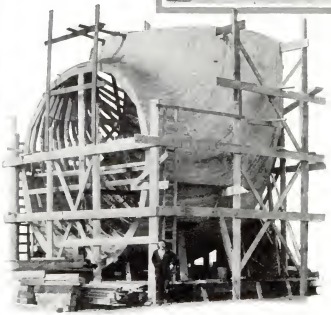
FAR beneath the feet of tramping millions, the longest tunnel of its kind in the world is nearing completion in New York City. Twenty miles in length, it will help distribute a billion gallons of water a day to New York homes and factories. Officially, the shaft will be known as City Tunnel Number Two. City Tunnel Number One, completed fifteen years ago, has long been overtaxed. Hence 2,500 workmen have been toiling day and night for the last three years to construct the supplementary tunnel. To cut it through solid rock, they exploded 8,000,000 pounds of dynamite. Blasting went on twenty-four hours a day without disturbing surface dwellers, although the tunnel runs beneath one of the most densely populated areas in the world. A railroad train could be driven through the new fourteen-foot shaft.



Above, tunnel in course of construction. Twenty-five hundred men have used 8,000,000 pounds of dynamite in blasting the tunnel through the island's solid rock

PHOTO, FAIRCHILD AERIAL SURVEYS, INC.

Remarkable air photo of New York City showing the new tunnel, and the old, forming a loop around city. Water may be run through both or either of them



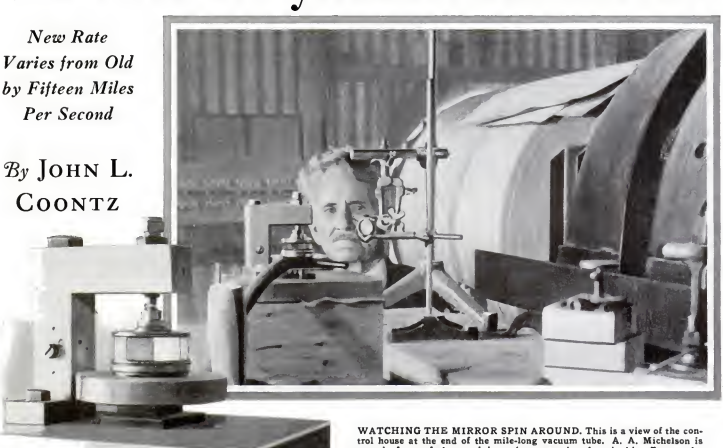
Within the wooden cage, above, the Bucyrus-Erie compressed air shovels were treated at the factory to be sure there was room for them to work in tunnel. They can pick up a load, swing around, and dump it in the cars standing behind them

This gigantic wooden form, left, was used in casting one of the bends in the concrete lining of the tunnel. Workman in foreground gives idea of tunnel's great size

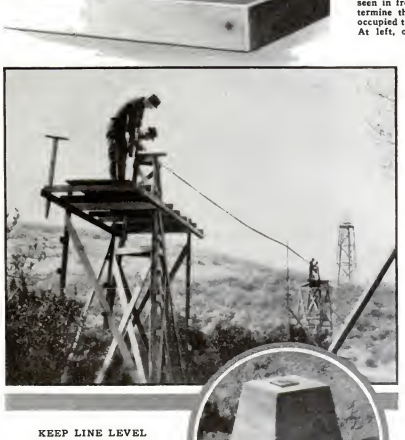
· Find Mysterious Error

New Rate Varies from Old by Fifteen Miles Per Second

By JOHN L. COONTZ



WATCHING THE MIRROR SPIN AROUND. This is a view of the control house at the end of the mile-long vacuum tube. A. A. Michelson is seen in front of the revolving mirror securing data in his effort to determine the exact speed of light. For long hours during the tests, he occupied this position, hardly for a second taking his eye from the mirror, At left, one of the eight-sided mirrors used in making experiments



KEEP LINE LEVEL TO INSURE ACCURACY

So accurate must the measurements of distance between two chosen points be in the study of light velocity, that platforms were raised in valleys to maintain the right elevation. At right, concrete marker from which the line was measured

FROM the world's largest vacuum tube, stretching like a mile-long arrow over the flat floor of a California valley, near Santa Ana, has come a mystery that is puzzling scientists. Built by Dr. A. A. Michelson, famous University of Chicago physicist, shortly before his death last year, the $50,000 tube was designed for super-accurate measurements of the speed of light.

Five years ago, Dr. Michelson flashed a beam back and forth between mirrors, mounted on twin California peaks twenty-one miles apart, and clocked light's speed at 186,284 miles a second. The possibility that slight "shimmers" in the atmosphere had caused minute discrepancies in the results, led him to construct, with the aid of the Carnegie Institution of Washington, D. C., the 100-ton corrugated steel tube. From it, powerful pumps, working forty-eight hours, extract the air so that multi-sided mirrors, spinning at high speed, can shuttle back and forth a ray of light in what is practically a vacuum.

To determine the exact distance from spinning mirror to spinning mirror, the U. S. Coast and Geodetic Survey sent Commander Clem L. Garner to Santa Ana. Garner was the man who measured the distance between the peaks used in the earlier experiment. Beside each end of the steel pipe, he placed a stone marker and then began his painstaking, exact measurements. When he had finished, Dr. Michelson and his associates, Dr. F. G. Pease, of Mount Wilson Observatory, and Fred Pearson, of the University of Chicago, set their instruments up within the tube, exactly on line with the markers.

Working only at night, when the heat did not distort the glass of the delicate revolving mirrors, they began their tests, flashing beams of light back and forth down the long black tube while recording apparatus clocked their near instantaneous passage. Five thousand

in Speed of LIGHT ·

All the seams in the mile-long vacuum tube were carefully closed with paint after being riveted. In addition, the joints were made air-tight with split inner tubes from auto tires

times they repeated the experiment. The final tests were directed from his sick bed during Dr. Michelson's last illness.

Then came the surprise—and the mystery. Comparison of the results with the figures obtained a few years earlier on the mountain peaks showed they differed by *fifteen miles a second!*

What was the cause of the startling discrepancy? Were Garner's measurements wrong? An SOS to Washington brought E. B. Latham from the Coast and Geodetic Survey. Carefully, he worked from marker to marker and found the measurements correct. Had the instruments been placed in the tube out of line with the markers? Tests showed they had not. Had the distance between the mountain peaks, used in the earlier experiment, increased or decreased through earth movements between the time the measurements were taken and the tests of light velocity made? Major William Bowie, Chief of the Division of Geodesy, U. S. Coast and Geodetic Survey, reported a survey made after Michelson had concluded his mountain tests showed the distance between the peaks had remained the same.

Yet the puzzling fifteen-mile-a-second difference remains, mystifying the experimenters. It has been suggested that the speed of light, thought constant, may vary.

As this is written, the Coast and Geodetic Survey is once again going to Santa Ana. For a third time, it will stretch its tape beside the mile-long tube to check the distance between the markers to the fraction of a millimeter. At the same time, Dr. Pease, who has taken up the work laid down by Dr. Michelson, is checking every possible source of error before beginning a final group of 18,000 tests.

This ion arc light threw its beam upon the revolving mirror in the control room, whence it was reflected into the vacuum tube where other mirrors tossed it back and forth until it returned at last to the revolving mirror

SMALL ARMY TRACTOR WHIRLS BIG GUNS INTO ACTION

With this British army tractor, big field guns are whirled into action

ARTILLERY goes into action faster than any team of horses could drag it, when it is whirled around the field by this British tractor. Great mobility for all weapons of war, even the largest, is now the aim of all army engineers. It is in line with this idea, that fast tractors and tanks have been developed for the purpose of moving field pieces. These tractors not only are faster than the horses they replace but they are able to cross terrain where horses would have been stalled. Recent maneuvers have demonstrated the tractor's marked superiority. Note the machine's low center of gravity and fast running tread.

Dr. Eugene H. Eising, New York surgeon, exposing to ultra-violet light ordinary petroleum jelly. It receives its curative power as it slides down the inclined sheet

How Strange Chance in a Doctor's Office Revealed

Mystery RAYS that

This photo was made by strange rays that come from wings of butterfly. Note. rays passed through cellophane strips but were stopped by glass disk and quartz. Plate exposed for twelve days

A MIDDLE-AGED man walked into a New York surgeon's office for examination of a wound, a few months ago. For a whole year following an operation, the wound had failed to heal. Repeated treatments by practically every method known to medical science had failed. This time, the surgeon's manner after examination conveyed no optimism.

The most he could do, he said, was to send the patient back to the hospital for an attempt at a cure by another operation. "Except—there's just a chance—" His eyes, glancing idly about the room, happened to fall upon a test tube hanging on a curtain.

He unhooked the test tube, and emptied its jelly-like contents into a surgical syringe. Despite difficulties in handling, the warm jelly was applied to the wound and covered with gauze.

Five days later the man returned. "Doctor," he said, "I think my wound has closed." It had. By some apparent miracle, a test tube of ordinary petroleum jelly, taken on the vaguest chance from in front of an ultra-violet lamp where the surgeon had been using its natural fluorescence to test the strength of the rays, had succeeded where the best remedies known to medicine had failed.

It was thus that Dr. Eugene H. Eising, New York surgeon, discovered an entirely new kind of healing agent. This irradiated petrolatum, or rayed petroleum jelly, has strange attributes. Its action combines a general healing effect and a positive germ-killing quality, the latter effect differing from standard antiseptics in being a prolonged, rather than an instantaneous, action. Strangest of all, the preparation's curative power seems to depend upon an invisible mystery ray that comes from the jelly, a phenomenon demonstrated by the rays' ability to fog a photographic plate in total darkness.

Even though the working of the mysterious jelly is still not fully understood, it is considered of great importance to the public. A large manufacturer of pharmaceutical preparations is compounding it already under the name of "radolatum" —short for irradiated petrolatum—and at this writing, it is available to physicians. Now plans are being made to introduce it to the general public, and drug stores may have it on their shelves by the time this appears in print. Radolatum eventually may become a standard remedy in every household medicine cabinet. Tests in some of the country's foremost clinics show its amazing versatility and effectiveness in treating such everyday ailments as burns, scalds, boils, and sunburn, in addition to more serious surgical cases.

If such everyday wonders as X-ray tubes and ultra-violet lamps still impress the layman, what is one to say of Dr. Eising's preparation and its mystery rays? Or of a newly-announced process that physicians may soon be using to fight cancer, in which ultra-violet rays are generated deep inside the human body? Or, again, of strange invisible rays for which no use has yet been found, such as come from the wings of butterflies and print their image upon a photographic plate? Here are vivid examples that, so far, we have only scratched the surface of a whole mysterious range of radiations, and that new wonders may follow their harnessing.

As a start in learning of the latest ray discoveries, I went to Dr. Eising's laboratory to obtain the first-hand story of his mystery rays.

In a curtained-off corner of his laboratory stands a large ultra-violet lamp used for treating patients. With such a lamp, Dr. Eising explained, it is customary to use an indicator showing the strength of the rays. Such indicators usually consist of a small transparent capsule enclosing chemicals that, under ultra-violet radiation, glow with brilliant blue or green light. Sometimes the capsules break and must be replaced. Dr. Eising discovered that a test tube of ordinary petroleum

Dr. Eising with the colored filters he used in an effort to identify the light that gave petroleum jelly its remarkable power. At right, apparatus employed to prove radolatum rays affects photographic plate. Print shown was made from plate exposed to rays

REMARKABLE emanations from Petroleum jelly startle the medical world —new method found to produce ultra-violet rays inside the body to fight cancerous growth

By ALDEN P. ARMAGNAC

Cure Disease

Dr. A. J. Allen, discoverer of the method of generating ultra-violet rays inside the human body, is preparing the fluorescent chemicals used in his new process which is expected to be efficacious in treating cancerous growth

jelly—which fluoresces with a blue glow under the rays—made a satisfactory indicator, when hung on a curtain near the lamp.

It was this tube of jelly that Dr. Eising took from the curtain, where it had hung before the lamp for hours, to treat his difficult patient. Whatever lucky inspiration moved him to do it, he realized he had made an important discovery when the same preparation worked with signal success upon other patients. Then he began to search for the explanation of its amazing healing power.

At first, he though it might be due to vitamins, formed in the petrolatum by the ultra-violet rays of the lamp. He discarded this theory when he found that ordinary petrolatum, artificially impregnated with vitamins, had no such powers.

"After fumbling around for a while," Dr. Eising says, "it occurred to me to place some of my irradiated petroleum with a photographic plate in a light-tight box." He cut a design in a cardboard stencil, placed the stencil between a photographic plate and a dish of the rayed jelly in a darkroom, and then left the combination overnight in a box from which all light was excluded. When he removed and developed the plate, the result was startling. The plate bore a perfect image of the stencil, as plainly as if printed upon the sensitive emulsion by a powerful lamp.

Ordinary petroleum jelly, not irradiated, has no such power. By exposing different batches of jelly to his lamp under variously colored glass and quartz screens, Dr. Eising proved that it can be activated only by a special, restricted part of ultra-violet light known as the "cyanogen band." This type of light is present in normal sunlight, but is available in more concentrated form in artificial lamps.

Evidently exposure to this light gave petroleum jelly the power of emitting some mysterious, invisible ray that affects a photographic plate in total darkness. New tests showed that the curative power of the jelly and the emission of the mystery ray seem to go hand in hand. Inescapable was the inference that the ray is partly or wholly responsible for the healing result. What could be the nature of the ray?

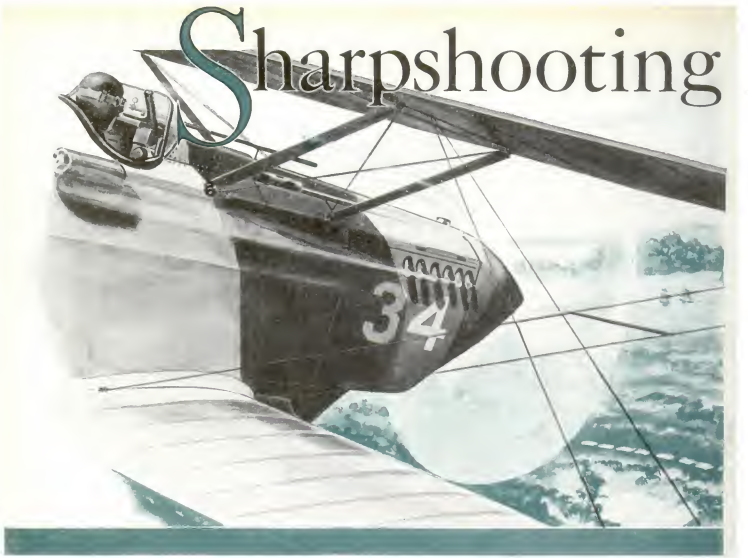
Could it be that the jelly re-emitted ultra-violet rays for some time after exposure? If so, the rays should behave like light rays, and pass readily through transparent pieces of quartz and film. Dr. Eising found the rays actually did pass through a protective layer of celluloid film and affect one of his plates, but in the crucial test they failed to penetrate thin plates of transparent quartz. Moreover, he found he could keep the mysterious emanation from affecting a plate by blowing a gentle jet of air between jelly and plate, during exposure. Conversely, when he led the emanation from a flask of warmed, irradiated jelly through a glass tube to a plate, it left a dense black smudge on the developed plate. These tests suggest that the emanation may partake both of the nature of a radiation and of a vapor.

Less mysterious than the rays from radolatum, but perhaps as richly fraught with significance in battling disease, is an ingenious process that makes it possible to use ultra-violet rays, ordinarily of feeble peneration, for destroying cancer cells in deep-lying parts of the human body. Dr. Ellice McDonald and Dr. A. J. Allen of the University of Pennsylvania, who announce the new method, expect it to prove an invaluable aid in fighting cancer.

In the new process, suitable organic chemicals are injected and find their way to the deepest recesses of the human body. Then X-rays are applied from the outside, near the spot to be treated. The penetrating X-rays touch off the ultra-violet "bomb" and generate ultra-violet rays inside the patient's body.

When more research has thrown full light on the ray phenomena, medicine will have new weapons to battle disease.

Sharpshooting



Uncle Sam's War Birds Pour Lead into Targets While Their Planes Fly at Hundred Mile Speed

By EDWIN TEALE

WITH a five-foot belt of cartridges dangling limply from one arm like a dead snake, a mechanic clambers on the lower wing of the army biplane. The war birds of the Fifth Observation Squadron are holding annual machine gun practice at the Aberdeen, Md., Proving Ground and I am to fly over this no-man's-land, where government experts test big cannon, to see for myself how sharpshooters of the sky are trained.

Our Douglas biplane, 34, is warming up on the starting line before immense metal hangars. Lieut. Erickson Nichols, brother of the noted aviatrix, Ruth Nichols, and one of the crack shots of the squadron, helps me buckle on my parachute. He is to pilot me "over the lines" to the diving targets eleven miles away.

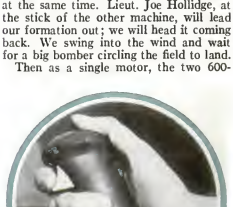
While the mechanic is loading our Browning gun that pokes its stubby black barrel from the motor cowling, a chrome-yellow Falcon, its wheels still spinning from the takeoff, roars into a climbing turn less than thirty feet above our heads. It carries a "flexible" gun which the observer can fire to either side from the rear cockpit. Our Browning is a "fixed" gun, spitting 1,200 bullets a minute between the blades of the whirling propeller. A driving mechanism, attached to the cam shaft of the motor, fires the gun. The bullets, leaving the muzzle at a speed of half a mile a second, pass each propeller blade six inches back of the trailing edge.

Last year, Capt. E. E. "Tiny" Harmon, the six-foot-three, 215-pound commanding officer of the squadron, hopped off for the diving targets with a belt of old ammunition. Some of the cartridges "hung fire" for the fraction of a second. The jacketed lead struck the whirling blades and he limped home with three bullet holes in his steel propeller. That was 1920 ammunition. Ours, due to government economy, is even older, some dating from the last stages of the World War in 1918!

Incidentally, I learn just before we taxi out on the field for the takeoff, our chances of making a forced landing near the fixed gun range are about the same as going safely over Niagara Falls in a leaky rowboat. Huge shell-holes pit the open spaces. All a pilot with a dead engine or a broken propeller could do would be to "settle" down between holes at the lowest possible landing speed—about fifty-five miles an hour—and trust to luck.

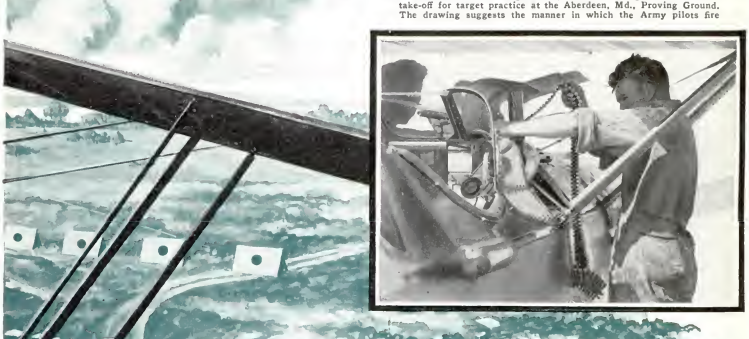
We are half way down the field, wing to wing with a sister-ship, No. 35. Two planes always work on the diving targets at the same time. Lieut. Joe Hollidge, at the stick of the other machine, will lead our formation out; we will head it coming back. We swing into the wind and wait for a big bomber circling the field to land.

Then as a single motor, the two 600-



Here is the electric trigger, contained in a rubber handle that fits on the control stick, which sets the Browning gun into steady action

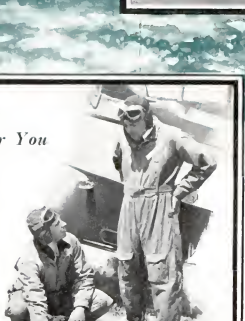
from the Clouds



Below, mechanic loading an airplane's Browning gun before the take-off for target practice at the Aberdeen, Md., Proving Ground. The drawing suggests the manner in which the Army pilots fire

Ready to Fly in Quest of First Hand Facts For You

Here is your author himself, standing, right, while Lieutenant Erickson Nichols tells him what they will do and where they will go when they are making their target practice flight over Proving Grounds at Aberdeen, Md. What he saw, felt, and learned while the plane swooped down and the machine gun rattled, he tells you in this thrilling article which is packed with the hair-raising drama that goes with this spectacular form of training for air marksmen



horsepower Conqueror engines howl at full throttle and we are off, heading straight for the big hangars. They loom against the sky like great gray mountains while the ships scuttle along the ground, hugging the earth. At what seems the last possible moment, we lift into the air and soar away. Yellow planes, a winding railway, and a mile-long row of cannon barrels lying side by side, like a corduroy road of metal logs, flash past below our landing wheels.

We swing in a wide circle to the left out over the slate-gray, choppy waters of Chesapeake Bay, with its root-like creeks and inlets, and come back over the proving ground at 1,000 feet. A strange row of giant hoops, through which experts fire big guns, slips to the rear beneath our wings. We head south over wasteland and marshes where clusters of isolated buildings carry red disks on their sides to warn of the danger areas in which are housed the high explosives.

The air is boiling. Our ships pitch up and down, up and down, dropping and tossing fifteen feet at a time. Gusts slap them from side to side, rock and tilt the wings. Hollidge, with the winking owl and winking moon insignia of the squadron on his fuselage, is less than fifty feet away and a little in the lead. He ducks his head from side to side, constantly on the alert. It is a dangerous day for formation flying. Nichols watches him like a hawk, throttling and opening his motor, edging in and swerving out, keeping his place and avoiding a crash by the skillful piloting acquired on a great many flights.

High overhead, three coal-black buzzards wheel in the sky; the only sign of life in a perpetual no-man's-land. A deserted concrete road crawls to the far end of the peninsula. Closed gates and fluttering scarlet flags warn that gunnery practice is going on and the life of no intruder would be safe.

Then, below, we catch a flash of yellow. The Falcon with the flexible gun scuds past chasing its shadow. It is heading home for more ammunition. Ahead, are four strips of white, with a wide black line running down the middle of each, laid out in an open space. They are the flexible gun targets, twenty-four feet long and six feet wide. The black center strip is the bullseye. Two targets are flat on the ground; two set up at an angle of sixty degrees. The gunner in the rear cockpit fires straight down, from 200 feet, on the flat targets; from the side, while flying along a line 400 feet away, on the ones that are set up and which look as though they could easily be hit.

On both sides of us now, inlets come in from the bay. We are nearing the end of the peninsula. Saltpeter Creek and the Penny-Come-Quick area lie behind;

SLEEVE TARGET FOR AIR GUNNERS. This twenty-foot sleeve of cloth, with black band as bullseye, is towed through the air at end of steel cable and air gunners shoot at it, as shown in drawing at right. Such target practice generally is carried on some distance from land

Gunpowder Neck ahead. On the map of the proving ground, a black line runs down the middle and carries the legend: "Planes Must Not Fly East Of This Line." Across the line, big shells from heavy ordnance scream through the air during testing periods. To reduce the danger, the crashing boom of the big artillery doesn't begin until afternoon, while the planes are in the air from six to eleven in the morning. For the flyers, the day's work is over at eleven A.M.

We pass Sod Run and above the leading edge of the lower left wing appears a point of land jutting into the bay. On it is a pock-marked open space—the fixed gun range. Four tiny white rectangles, propped up at sixty-degree angles, stand in a row across the center of the field. They are the targets, ten feet high, six feet wide, with black bullseyes more than two feet in diameter. We are to take targets one and two, the pair on the left; Hollidge three and four. On our next trip, with another belt of 100 cartridges, we will work on three and four and Hollidge will switch over to one and two.

Suddenly, the metallic blast of the propellers and the bellow of the motors sink to a steady drumming. With throttled engines, we slide down half a thousand feet in a wide sweep to the right and come back heading into the wind.

The observers' headquarters, at the edge of the clearing, rushes under us. A concrete wall, twenty feet high and two feet thick, protects it from ricocheting bullets. On the far side of the building, as we race by, a man in brown overalls is half way up the ladder of a high observation tower. At its top, a crimson danger flag darts in and out on the gusty air like the tongue of an angry snake. Gusty days and hot days are the worst for flying gun practice. Heat-bumps and ground-gusts cuff and slap the planes so that holding the bead on the bullseye for any length of time is impossible.

Under us, a hundred feet from the building, is a great white rectangle. It is made up of twenty-eight hinged panels. They are white on one side and black on the other and form the communication system between the ground crew and the airmen. When the white sides are up, the signal is: "All is Clear. Begin Firing!" When the black sides are up, it means: "Don't Fire!", and when the panels are alternately black and white, the message is: "Cease Firing and Go Home!" Before any of the ground crew ventures into the open, the panels are always turned black-side-up.

To drop the sleeve target, this weight is released so it can drag the ring along the cable and trip the catch

Across the field, in front of the targets, are two parallel lines. They are formed by a series of cloth rectangles laid on the ground and look, from the air, like rows of white hyphens. The first line is exactly 400 feet in front of the targets, the second 1,400 feet. The space between the two is where the firing is done. We cannot begin shooting until our ship has passed the 1,400-foot line; we must stop before we cross the 400-foot one. Observers, far out at the ends of the lines, watch the planes and listen to the sound of the gun to detect violations of these rules. Five percent is deducted from the score for every time a pilot keeps on firing beyond the 400-foot marker.

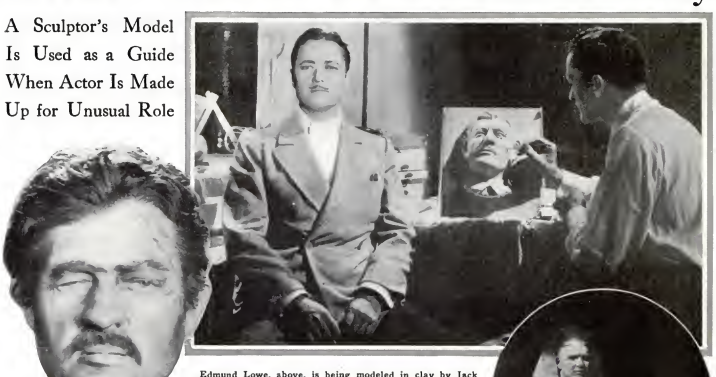
Hollidge has swung away to give us room. We are to dive first on the targets. Nichols is leaning ahead. He jerks back the charging handle of the machine gun. A live round clicks into place. On the instrument board, he flips up a little white knob marked "Gun Switch." We are diving on target number one, ready for action.

The 1,400-foot line sweeps to the rear. The ground comes rushing up; shellholes are streaking past. The black and white target expands before the nose of the plane. Then Nichols' right forefinger moves a fraction of an inch, pressing the electric trigger near the top of the control-stick. Rat-a-tat-tat! Like the sound of a pneumatic hammer, the high, metallic clatter of the gun cuts through the roar of the motor. Half a dozen empty cartridges pour down a chute and drop out the side of the fuselage. Acrid smoke swirls into the rear cockpit. Little puffs of brownish dust spurt up behind the target. Good shot! When bullets kick up dust it is a sign they have hit the mark. For, around the targets is sod; directly behind them little open patches plowed and pulverized by flying lead.

We are barely thirty feet in the air when the 400-foot line flashes by and we rocket up in a climbing turn to the right. Clouds sail by our upper wings, trees blur past the lower tips as we wheel for another dive. Hollidge is going down. His plane and its shadow seem to meet, then part, as he swoops close to the ground. The sound of his gun is like the distant rattle of a stick along a picket fence. We are allowed ten *(Continued on page 108)*

Create Movie Characters in Clay

A Sculptor's Model Is Used as a Guide When Actor Is Made Up for Unusual Role



Edmund Lowe, above, is being modeled in clay by Jack Dawn as the first step in creating s makeup for the screen. At left, Lowe made up for part. Note bulging nose and scar

MOVIE actors no longer struggle with makeup in an effort to get the right effect. Clay models now take the place of human beings while Jack Dawn, sculptor and makeup artist, traces in soft clay the lines of age, terrible scars, or a mustache. Three or four simple tools and deft fingers create in an hour a character that could not be completed on a human face in less than a day of constant effort.

Formerly, makeup artists did all their work on the actor's face and body, building up several conceptions of the character before one acceptable to the director was found. Now Dawn, with the actor sitting before him, models his face in clay, adds the character to the model, and has it approved before he begins to rub grease paint on the actor's face.

In making up Edmund Lowe recently to play the part of a middle-aged crook, Dawn was asked to try a bulging left nostril and a scar on the left forehead. On the tiny model, standing out in relief from a board, he pulled out the clay nose and scraped his scalpel through the head. The effect was what the director sought, so then he "built up" these disfiguring marks on the actor himself and the desired character was complete.

Dawn considers his most difficult task was the creation of a statue that came to life suddenly. Here, again, he worked with a model. First, he created the clay counterpart of the actor's head. From that, and measurements of the actor's body, he completed a papier mache model. After coloring this figure to look ancient, he proceeded to make an antique of the man.

Raw umber, burnt umber, burnt sienna, and red lake, properly mixed, gave him the reddish gray found in old Egyptian stone. Sawdust stuck on with fish glue provided age. A second coating of glue, mixed with sand and applied in spots, gave the impression that time had worn the figure away. After the actor was stood in place on the set, fuller's earth dropped from above and blown on from the sides made him look as though he had stood there for centuries. Yet each night the actor in a few minutes removed all these things under a hot shower. Each pigment had been chemically tested to avoid impurities and possible infection.

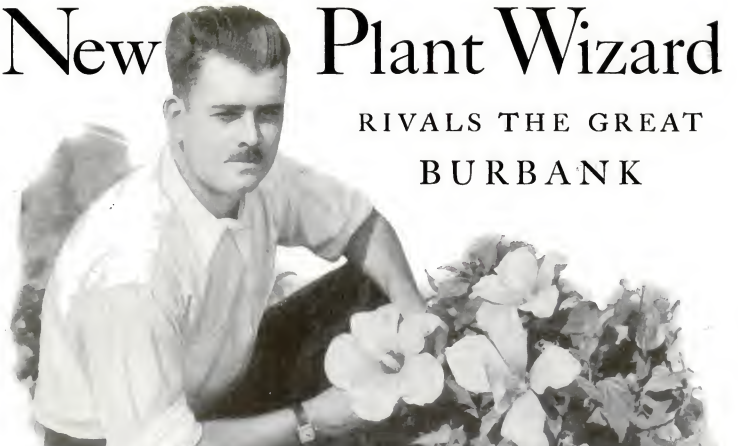
"I model all difficult characters," Dawn explains. "We seek effects, but never use anything likely to injure the skin. Seldom do we obtain any grotesque effects by drawing the skin. Makeup 'built up' on the skin usually is sufficient to give the sought-for appearance on the screen."

This ststue that csme to life was made first in clay and papier mache and then the effects were transferred to the actor with vegetable dyes, glue, and fuller's esrth

At left, Paul Muni and the clay model from which he was made up. The tiny model was made in less than an hour by the movie sculptor

New Plant Wizard

RIVALS THE GREAT BURBANK



William H. Henderson in his Fresno, Calif., garden, with the giant six-inch hibiscus he has developed

By Clarence Ebey

PLANTS that grow nowhere else on earth bloom in the gardens of William H. Henderson, near Fresno, Calif. With 150 new flowers, fruits, and vegetables to his credit, this young experimenter, less than thirty years old, is carrying on the work of the world famous plant wizard, Luther Burbank.

Among his creations are a species of Golden Bantam sweetcorn with twice as many kernel rows on every cob; a seedless Muscat grape that ripens and can be placed on the market months before other known varieties; roses that are velvet red and edged with black; iris that are tinted like orchids.

By crossing sugar beets with Swiss chard, he has produced a giant red-stalked chard, three or four plants of which provide the average family with greens for many months; with the aid of night-flying moths as big as humming birds, he has developed a new species of gladiolus, the flowers of which are no longer scentless but possess a beautiful perfume.

In 1922, Henderson graduated from the Fresno High School. He had always been passionately fond of working with plants, so he wrote to Luther Burbank asking for employment in his Santa Rosa experimental gardens. Out of 1,500 applicants for such work, he was the one selected. His first job was pulling weeds at $15 a week. For four years, he remained with Burbank, learning of the mysteries of plant life from the master horticulturist. During the last two years of Burbank's life, he was his trusted assistant. In 1926, when Burbank died, Henderson returned to his step-father's ranch, near Fresno, and began experiments of his own.

One of his first accomplishments was the development of an improved zinnia. These common flowers, so ordinary-looking they are often nicknamed "the kitchen garden flower," are usually dull in color and ungainly in appearance. By cross-breeding and selection, Henderson increased the brilliance and clearness of the colors and lowered and broadened the plants, making possible bedding that will present a mass of rainbow hues. The most striking of his new zinnias is tri-colored. It has an outer circle of lavender, an inner circle of cream, and a center of pink.

A giant, ever-blooming amaryllis, a lily-like flower that originated in South Africa, is one of his recent achievements. Common varieties were crossed with evergreen types to combine the ever-blooming feature with a new range of colors and petals of unusual size. Many of these massive blooms have a diameter of fourteen inches—more than two inches greater than the length of this page!

ANOTHER giant flower that grew for the first time in Henderson's garden is an improved hibiscus, or mallow, of unusual hardiness and arresting colors. New varieties of Shasta daisies have resulted from other experiments. Among them are some with strange, quilted petals and many with unusually large blooms. Under test and observation, at present, Henderson has about 13,000 new iris plants. Among the newer colors he has produced in these flowers are an almost clear red, orchid shades, a sky blue, and a red and bronze combination.

IN ALL these experiments, thousands of plants must be grown and destroyed to obtain a handful of promising specimens. For example, out of a field of 2,000 iris, only four were selected for further use and the rest were burned. Again, of 5,000 zinnias, only ten were found fitted for further trial. The greatest skill is required in this process of selection and in the work of hybridization, or cross-breeding.

In the latter task, a touch of pollen taken from the stamen, or pollen-bearing organ, of one flower is placed on the pistil, or seed-bearing organ, of another. The seeds resulting from this artificial fertilization are carefully planted. When the hybrid plants bloom, only the ones that approach most closely a desired combination of qualities inherited from the two parents are saved. These are again cross-bred and this process continues for several years until a new type of plant, with new qualities, has been evolved.

Probably the most difficult task of cross-breeding Henderson ever had was during his work with Muscat grapes. His goal was a new kind of grape, without seeds, with the flavor of the Muscat and ripening in July instead of in September or October, the time when these grapes usually appear on the market.

The first step was taking pollen from the flowers of a seedless grape. This he shook off by hitting the flower clusters

Above, Henderson working with zinnias of which he has produced several new varieties. At right, the giant zinnia he has created and above it, left, his baby zinnia, to the right of which is a zinnia of the ordinary size

FRUITS and Flowers Are Shaped into New and Startling Forms in the Gardens of This Wonder Worker

Henderson has made his Golden Bantam corn seven inches long, as ruler shows, and has increased the number of rows, eight in old variety, to sixteen with larger kernels

against the edge of a saucer. The next day, this fine fertilizing dust was placed on the flowers of a Muscat vine. This was a tremendous task. In each Muscat cluster are about 2,000 flowers, each only a sixteenth of an inch across. In addition, a tiny cap fits over the pistil, covering the anthers, or pollen-bearing parts of the stamen, on every flower. Therefore, it was necessary to perform a delicate operation on each minute flower, removing the cap and anthers with a small pair of tweezers before applying the pollen. This was rubbed on the pistils which carried it downward, fertilizing the ovaries.

Four hours a day, day after day, this nerve-straining work went on. About 500 flowers in a cluster of 2,000 were treated. When the fruit from this crossing had ripened, about 5,000 seeds were saved and planted, first in a sandbox, then in individual pots, and finally in the vineyard.

Out of these 5,000 plants, 480 were selected for further experiment. They have been growing for nearly five years and have become huge vines. Last year, Henderson opened eight or ten grapes on every vine and found one vine with all seedless fruit and many with only a few grapes having seeds. The seedless vine bears large-size fruit with Muscat flavor.

About twenty-five of the 480 vines fruited last year. This year, with eighty-five percent fruiting, Henderson has found another completely seedless vine. The grapes from it are a golden color and possess the desired Muscat flavor. Since the ripening time of these grapes is several weeks ahead of the usual time for Muscats, they are expected to prove of great commercial value. *(Continued on page 106)*

This Egyptian Moth, by carrying pollen from one flower to another, aided Henderson in developing his giant gladiolus, an armful of which is held by the child in the photograph above

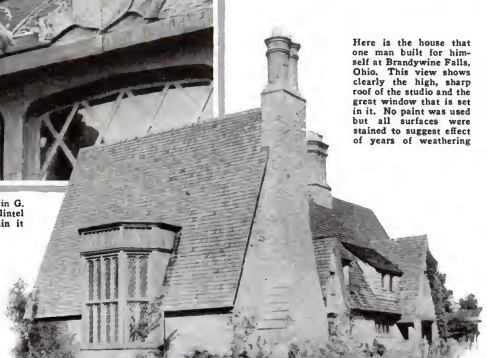
A FEAST FOR A FAMILY

This Crimson Chard produced by Henderson, has brilliant red stalks and red veins in its leaves. The ruler shows stalk is thirteen inches in length and leaf approximately twenty-two inches long

How One Man Built

This Article Tells House Came True and Your Spare Time to

To make his home as attractive as possible, Edwin G. Sommer, spare time house builder is carving a lintel above one of the windows. Later he will stain it



Here is the house that one man built for himself at Brandywine Falls, Ohio. This view shows clearly the high, sharp roof of the studio and the great window that is set in it. No paint was used but all surfaces were stained to suggest effect of years of weathering

DREAM houses usually prove costly, and rarely emerge from the paper on which their plans are drawn. But at Brandywine Falls, south of Cleveland, Ohio, is one dream home that came true because the owner, Edwin G. Sommer, an artist, built nearly all of it with his own hands. It is truly a home-made house, the product of spare-time labor. In building it, Sommer demonstrated that there are many short-cuts and economies with which home-builders can save money and produce a house with a personality.

The Sommer home has thirteen rooms, and is built to last for centuries. It is of the English Tudor style of architecture, being patterned after houses built before Columbus first crossed the Atlantic. To duplicate it by the usual methods of building would cost at least $50,000, but it cost Sommer only a fraction of that amount.

Construction work has been in progress for nearly four years. That may seem a long time, but it is no greater than the average home-builder spends in making plans and scraping together enough money to do the job in the usual few months. Then, considering that according to Sommer, about seventy-five percent of the work was done by himself, the time required was not great. Although as a whole completed, there are numerous little finishing touches to be applied here and there before the builder will be satisfied.

Almost immediately the savings to be made by the "build-it-yourself" method became evident. Sommer dug the cellar with pick and shovel, finding the task a relaxation after hours spent at his regular work indoors.

The walls are of brick which, as every builder knows, is not a particularly cheap material. But Sommer was after a particular effect that could not be produced by new brick—the reproduction of walls of ancient English houses. So he went collecting. From an old church he obtained used bricks that required only to be cleaned before they were ready for laying. From an old office building he obtained more bricks, and from other sources still more. At one end of the house can be seen bricks from four different sources; but they blend together so perfectly that the casual observer never would know it.

The walls grew under the hands of the owner, helped by laborers called in to do the heaviest work. Also he found it advisable to hire specialists to do the wiring and plumbing and other forms of work requiring special knowledge.

Material for the framework came from old buildings. Huge, hand-hewn

Close-up of studio window which, without its leaded glass, weighs three tons and is the home's most unusual feature

a $50,000 HOME

How One Dream Shows How To Use Get What You Want

By
WALTER E. BURTON

Above, one of the big chimneys nearing completion and the roof with few shingles laid. Left, dormer which is outstanding detail of roof. Note corkscrew chimney

beams went into the structure—beams so seasoned with age that it was almost impossible to drive nails into them.

When the walls neared completion, the general form of the house became evident. At one end was a huge room, measuring twenty-two by thirty-seven feet, which was to become a studio. Next to the studio is a dining hall, a long, rambling room. The entrance vestibule opens into this room, as do the study, breakfast nook, and kitchen.

The studio room is the most unusual one in the house. The sharply pointed roof is typically English. Inside, the ceiling rises to a height of thirty-five feet, more than three full stories. To support the roof, fourteen huge fir beams, each twenty-nine feet long and measuring eight by twelve inches, were set into place with block and tackle. Accentuating the size is the enormous studio window, copied from one in a building at Warwickshire, England. The window, without the leaded glass, weighs three tons. It was built by a group of German craftsmen at Cleveland, and is one of the few units of the house that were not made on the site. At one end of the studio is a fireplace, of giant proportions like its surroundings. A full-grown person can stand inside it, with a foot or two to spare.

Floors of the house are of heavy oak boards, pegged into place. The final finish will be wax. Woodwork, other than the fir beams, is of oak and chestnut. Sommer searched the countryside for giant chestnut trees and finally found three not far from Brandywine. He bought the trees and had them cut into wide boards and split into shingles. He was surprised at the amount of lumber that he obtained. There was enough to make all of the hand-split shingles, which required a year of his time to lay; and enough to panel the walls of the study and breakfast room, for lintels over windows, and for other uses.

The chestnut-covered walls are typical of the method followed by the builder in order to obtain the effect he wanted. The boards are held together at the edges by butterfly wedges. The surface of the lumber was left uneven and given a wax finish after it was in place.

In the homes of Old England, walls are covered with a white plaster which, as the years pass, takes on a rich coloring from smoke and grease fumes pouring out of the huge fireplaces. Sommer does not want to wait years in order to obtain this effect; so, as soon as finishing touches are applied to the wall surfaces, he will build particularly smoky and greasy fires in the fireplace and in smudge pots, and let the fumes color the walls.

Being an artist and interior decorator, Sommer naturally has incorporated more detailed work into his home than the average builder would attempt. He is an expert wood-carver, wrought-iron craftsman, and cabinet maker. Close approach to the outside of the house at once reveals this. Here and there in the walls, particularly over the entrance doorway, are set little plaques *(Continued on page 107)*

WHY BUILD YOUR OWN HOME?

WHEN you build it yourself, you know exactly what kind of a house you have both in material and workmanship. Knowing every part of it intimately, your home has a personality and a character that no money can buy. This article tells you how one man built the home of which he had dreamed for sixteen years. You, also, can get what you want and save nearly seventy percent of the cost of a home built by a contractor. You have the fun of building for yourself and, in addition, you make excellent wages. It is merely a question of application, skill, and time.

Microphones Run This Office

Opening the door left, announces to the girl, right, in the control room, that a visitor has called. She speaks to him through the microphone seen in front of her and hears his reply over the loudspeaker. If the visitor presses a button beneath the mike in front of which he is standing, he can speak to the reception clerk

Here is the entire office organization in the palm of the hand. Pressing a button flashes a signal in the control room

Pushing a button on the small board, seen in center of the desk, signals the secretary, right, who answers through loudspeaker and receives dictation through mike on desk above. This does not interrupt the telephone service

TENANTS in the Haas Building, Los Angeles, Calif., have "electrical stenographers" to serve them by means of a loud speaker system recently installed. These girls, while seated in a central office, greet callers in any office, answer tenants' telephone calls, write letters, keep books, deliver messages, and keep undesired visitors out.

Four electrical channels make this system possible. Three of them are connected with the building's electrical circuit and use alternating current. The fourth, leading from office microphones to the stenographers, derives its power from induction coils and batteries in series.

Each tenant has a complete office organization on his desk—in the form of six push buttons on a small wooden block. If he wants to leave word that he is going out, he pushes the button marked, "office assistant." This flashes a light on the control board in central office, whereupon the tenant speaks whatever instructions he desires. By pushing any of the other buttons, he is connected immediately with the proper person. The devices do everything but think. If a tenant leaves without "checking out," the act of walking through the doors registers him "out" on the control board in central office. If a visitor tires of waiting, he pushes a button beneath the microphone, and leaves a message. All transactions with the employees are private.

HOTEL'S TANK CARRIES SIGHTSEERS UP MOUNTAIN

Sightseers in Bavaria climb a mountain in a tank car with tractor tread

RIDING up the side of a mountain in a tank is a new experience afforded tourists visiting at Oberach, Bavaria. One of the progressive hotels there has installed a thirty-four horsepower tractor tread tank for the use of its guests. In it they are taken to the top of Wall Mountain, making the ascent in about an hour. The tank has proved popular and others may soon be in use.

SOFT PLUG SEALS LEAK

Leaks in tanks can be plugged permanently without removing the contents, according to the manufacturer of a new plug. Composed of soft metal, it has a steel bolt ending in a hard nut. The plug is inserted at the point of the leak. Then the bolt is turned down, compressing the soft metal.

Air Driven Auto Goes Eighty Miles an Hour

CLIMBING steep hills covered with slippery ice is only one of the feats claimed possible for a curious air-driven automobile recently tested at Detroit, Mich. A four-bladed propeller, driven by a 100-horsepower engine, pulls it along like a tractor airplane. With a wheelbase of 132 inches and a weight of approximately 1,500 pounds, the strange machine is said to reach eighty miles an hour and cover thirty miles on a gallon of fuel. Because the wheels roll free and do not drive the car, it is not necessary for them to grip the ground as on a conventional machine. Consequently, the air-driven auto can travel along muddy roads or climb slippery hills without difficulty. To hold the machine on the road when it is going at high speeds, the front of the body top is slanted so the propeller's blast strikes it at an angle, pressing downward. Wire guards surround the whirling propeller blades to prevent accidents. According to tests, the inventor reports, the five-foot propeller gives four times as much forward drive to the machine as could be obtained by conventional rear-drive wheels, enabling the car to carry from six to eight people easily. A new 800-pound, three-passenger model is now under construction in which will be incorporated many refinements in the design. It is expected to cover forty miles on a single gallon of gasoline and will be able to attain a top speed of almost two miles a minute without running the danger of leaving the road or overturning.

Above, front view of auto driven by air propeller. Left, side view of car which is credited with eighty miles an hour

USE COFFEE AS FUEL IN BRAZIL LOCOMOTIVES

COFFEE beans are now being pressed into compact briquettes and used for fuel in locomotives and factories in Brazil. Due to conditions in Brazil, which produces most of the world's coffee, there has been an enormous oversupply of the beans this year. Hundreds of thousands of sacks were dumped into the sea before the idea of using the coffee as fuel was suggested. The dried bricks are said to produce ample heat for the boilers.

NEW WRITING KIT MAKES RAISED GOLD LETTERS

BY MEANS of a new ink and powder you can turn your ordinary writing into embossed letters of gold or silver. The writing can be done on paper or any other non-absorbent material. Over the freshly-written words, the powder is poured and the surplus removed by tapping the back of the sheet. Then the paper is held over a gas flame, electric hot plate, or alcohol lamp to fuse the ink and powder together.

Coffee pressed into bricks to be used as fuel in locomotives in Brazil

AIR-GUN FOR CAR FOILS BANDITS

LATEST defense against motor bandits in England is a compressed air pistol carried on the steering column of the car within instant reach of the motorist. The weapon, which shoots bullets and makes a loud report, is manufactured by a Birmingham gunsmith. Because it is operated by compressed air and not by explosives, it is said motorists can carry the arm without the necessity of taking out a firearms permit, ordinarily required by law.

England's Metal Bus Tested in Thrilling Crash with Truck

A THRILLING crash test, in which a four-ton steam lorry smashed head-on into the rear of a double-decked bus, was recently staged at Birmingham, England, to demonstrate the sturdiness of the all-metal construction of the bus. The only damage done the bus was a broken pane in a rear window and a dent in the body. The manufacturers of the new steel-and-metal coaches are emphasizing their safety features, putting on tests to prove they would minimize the number of fatalities resulting from bus collisions if adopted throughout England. The bus used in the demonstration crash was a double decker, similar to those now in service on London streets. The new bus is intended, primarily, for use in city traffic where the majority of accidents now occur, but its designers say it would prove highly practicable for use on the country highways in interurban traffic.

LIVE TREE IS MAST FOR DERRICK ON BIG JOB

A BIG pine tree, four feet in diameter, was turned into a derrick-mast by a western construction company without cutting down the tree or guying the top, the root anchorage proving strong enough to hold the tree in place in spite of the loads handled during the operations. The hoom was fastened around the trunk about twenty-five feet above the ground, and the outer end attached to a cable that passed over a sheave in the upper part of the tree. The tree was used during the construction of a rock fill dam.

GRAND OPERA WEAPONS MADE OF SCRAP IRON

GLITTERING battle axes carried by grand opera knights are now being made from scrap iron taken from the dump-heaps of steel mills. One western firm is specializing in producing ornate halberds and other medieval weapons from such pieces of discarded metal. Because papier-mache pikes and axes fail to clang realistically when clashed together in battle or when falling to the floor, metal weapons are favored for theatrical work. Further realism is added by giving the weapon a finish characteristic of those used centuries ago.

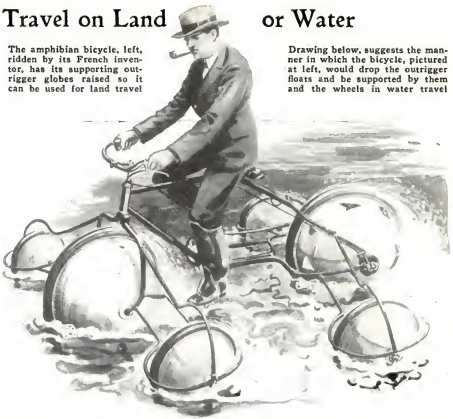
COMBINED CHAIR AND EASEL FOLD FLAT

FOR the convenience of landscape painters and etchers, a New York artist has invented a combined folding chair and easel. It folds into a compact object which can be carried under one arm, thus reducing to a minimum the amount of luggage required for a sketching trip. The combination chair and easel is adaptable for practically all sorts of artistic work, and can be used in the studio for portrait work as well as in the field for landscape painting. The easel is set at a convenient distance from the seat for sketching or painting.

At right is view of easel and chair that fold together to form flat object, shown above, so they are easily carried when the artist leaves studio for outdoor work

Amphibian Bicycle Can Travel on Land or Water

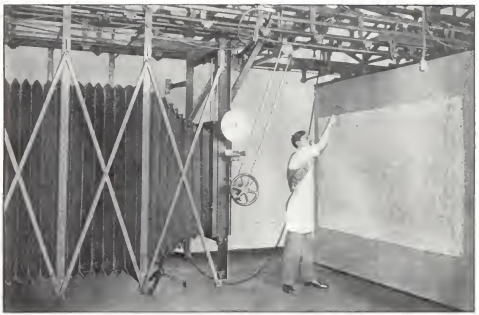
The amphibian bicycle, left, ridden by its French inventor, has its supporting outrigger globes raised so it can be used for land travel



Drawing below, suggests the manner in which the bicycle, pictured at left, would drop the outrigger floats and be supported by them and the wheels in water travel

A HYBRID among vehicles, an amphibian bicycle that can travel on land or water, was demonstrated by its French inventor at a recent Paris exposition. Its wheels are hollow, bulbous floats that, with the aid of four smaller globes on outriggers, sustain it in the water. All of the floats revolve freely like wheels, resulting in a minimum of drag. When the rider pedals across the water, fins on the rear wheel serve as paddles to drive the machine forward. For a ride on dry land, the outriggers supporting the outer floats may be folded up clear of the ground. Proof that the floats would be sufficiently buoyant to support the rider was given when the inventor navigated his device, without difficulty, across a large swimming pool.

UNCLE SAM GETS GIGANTIC CAMERA



Colossal camera, with eight-foot bellows and holder that will take a four-by-four-foot plate, is suspended in air and used by U. S. Geological Survey to take accurate photos

BIG enough for an eight-year-old child to walk through, a camera that can use any plate from four by five inches to four by four feet, has been designed for the U. S. Geological Survey. It is suspended from an overhead track twenty-five feet long and four feet wide. This suspension prevents vibrations from the ground or building interfering with the apparatus. The great size provides for copying with the greatest precision and accuracy.

Of the total weight of practically three tons, the bellows alone weigh 450 pounds. Its length, closed, is thirty inches; fully extended, it is eight and one-half feet. Even this is not enough for some of the work the camera is required to do, and additional length is provided by a thirty-six inch cone. The camera can enlarge eighteen diameters, or reduce a ninety-six inch drawing to two and one-half inches. The copy holder, weighing 1,000 pounds, moves on the track in either direction, and both it and the camera are mounted on roller bearings. Wet plates, dry plates, or paper may be used in the cameras.

MIRROR PART OF COMB

A POCKET comb that carries a mirror at one end is the handy toilet accessory produced by a Portland, Ore., inventor. The round glass is permanently set in the hard rubber of the comb. The "two-in-one" comb is five and a half inches long, slipping easily into pocket or handbag.

AUTO STOVE HEATED BY CHEMICAL REACTION

LITTLE larger than an open hand, is a fireless stove designed by an Italian inventor for heating automobiles. With a warming power of 200 calories an hour, it will run for thirty hours on one filling of gasoline. The fuel is not burned in the stove, which gives off no flame or sparks. Chemical reaction, induced by a catalysis apparatus within, produces the heat.

Chemical reaction heater for use in autos

What You Can Do *with*

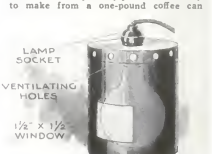
Strange New Worlds Will Be Revealed by a Powerful Lens, the Use of Which Will Be Described in These Articles

In focusing your microscope, you must remember always to turn it up to avoid injuring lens

On glass slides, like the one shown at left, the specimens are mounted. Below, the tools needed in working with a microscope. All of them are homemade with the exception of tweezers

WHAT YOUR SHIRT LOOKS LIKE
Highly magnified fibers of a shirt. The white strands are cotton threads and cross lines are silk

ELECTRIC LIGHT IS BEST. You will have better success with your microscope if you provide for artificial lighting as shown in the diagram below. This useful microscope lamp you will find easy to make from a one-pound coffee can



HAVE you ever explored the world within the world; the world of sights so terrifying and so beautiful that they strike you dumb; the world so filled with teeming life, minute carnivora and aquatic "monsters" that the rankest patch of South American jungle or the darkest haunts of deep sea life become by comparison mere playgrounds occupied by some of nature's most ordinary creatures?

No dream was ever peopled by denizens so foreboding, weird, ferocious, or wonderful as those that are brought to the eye by a modest little microscope peering down into a drop of water taken from a pond of stagnant water. Action! Color! Life! Nowhere is the struggle to live more intense, more dramatic, treacherous, or fierce.

Touring the sub-world with an inexpensive eye-piece is the most exciting pleasure that one can contemplate. We enter a dream world of life, death, destructions, glory, design, chaos, and tranquility.

In this series of articles we speak not of the highly specialized habits of *utricularia vulgaris* or the biological secrets of *serpula vermicularis*. Leave those studies to the technicians. We're mere tourists! It matters little whether we know the roads that we travel or the names of the towns that we pass through so long as we get a good view of the scenery! Animalculaeville or Crystaltown are but places to stop and treat our eyes. We don't have to be geologists to revel in the Grand Canyon nor do we have to be scientists to snatch views from a microscopic world.

How much will the trip cost and how much baggage shall we have to cart along? We travel by the aid of a small compound microscope of the students' variety capable of magnifying a hundred diameters. By a compound microscope, we mean a microscope on which there is an (1) objective and (2) an eye-piece or occular which in turn amplifies the image already amplified by the objective. If the objective magnifies fifteen diameters (times) and the eye-piece or occular five diameters then the total magnification of the microscope will be seventy-five diameters.

Cost? What would you pay for a trip to a land you had never seen in which were wonders by the score? The good news is that you do not have to be rich. Manufacturers of optical apparatus have taken care of the requirements of amateur tourists into this world of the unbelievably small and offer excellent small microscopes at prices that are easily within the means of all. In buying avoid mistake number one by NOT buying an instrument with higher power than that mentioned; that is not much higher. If you do, you will find the technique of operating it far beyond your training and you will become discouraged at the tollgate of a country far beyond your wildest dreams. Avoid mistake number two by carefully examining the glass of the instrument you buy. It must NOT be scratched.

Microscopes of the power mentioned may be purchased anywhere from twenty-five dollars up depending upon the number of refinements and accessories. Twenty-

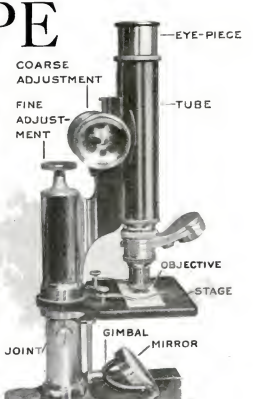
a MICROSCOPE

By Borden Hall

It is with these two knurled knobs that the microscope is brought into focus. The one at left is for coarse adjustment and the other for fine focusing

WHAT YOU SEE THROUGH A LENS

Above is a magnified view of the wax pincher on a bee's leg. At left, a cootie, celebrated in the World War, enlarged twenty times



Here is the instrument you will want to use with each part labelled. Its cost is $25 and upward

Here's a Hobby You Can Ride to Wonderland

IN THIS series of articles on the use of a microscope, a new and fascinating subject is brought to you. The articles will be written by an amateur microscopist, and exactly those things that one unfamiliar with the use of a microscope will want to know, will be told in a plain and simple way. Endless hours of real delight await you if you begin now to get ready for the entrancing excursions into an unknown world upon which this series will conduct you.

five dollars should be all that is necessary for we shall make most of our baggage as the tour goes on.

Those who have not operated a compound microscope have no idea of the world in which they find themselves, for we must keep well in mind the fact that we not only magnify motion but speed and distance as well. For instance, the magnified area of a fair powered instrument may be as small as ten one-thousandths of an inch and this is large compared to the really high powered eyepieces. Little wonder that we shall have to have (or develop) deft fingers. However, this is not a great chore where the lower powered machines are used.

Illumination is important, too. Properly will depend upon how cleverly, how patiently you arrange your illumination. A little practice will permit you to make the necessary adjustments quickly. It is a fault of the beginner to use too much light rather than too little.

Some amateur microscopists use daylight but the disadvantages are rather numerous. First, direct sunlight should not be used because of power and probable damage to the machine. A north light is difficult to control and is variable. The best arrangement is that of a low wattage electric light of the frosted white variety arranged in a tin can as illustrated. This is mounted in this way for the microscopists will find it best to work in a darkened room even with a low-powered to see things, we must arrange an artificial source of light so that it strikes the little mirror under the stage of the microscope and is reflected upward through the lens. This light must be nicely adjusted to suit your eyes, and will be found different for different people. It should not be too bright or it will cause fatigue and headache. Then it should be even so that the whole field of the lens will be uniformly illuminated. Indeed much of the success of your tour in Tiny-land instrument. Such a mounting prevents general diffusion of the light.

The distance the light is placed from the microscope and the degree of illumination will, to some extent, depend upon the individual and his sight. Of course, the experienced microscopist looks into an eye-piece with both eyes open while the beginner either squints one eye or closes it totally. While it might be rather awkward at first to use both eyes, it is really best as it minimizes fatigue and we gradually become so absorbed in the wonder revealed to us that we see nothing with the other eye even though it is open.

Now for some of the baggage we are going to make for ourselves. It is fun and it saves money. This business really calls for a small butcher shop, at least for biological specimens. The dissecting kit should be made up of a scalpel, a tiny pair of scissors (cuticle scissors used in manicuring will do), a pair of forceps, four needles set in handles, and a tiny camel's hair brush.

The scalpel comes first. It is the butchering knife and it must be sharp, so sharp that what it cuts will be cut and not torn. This little job is neatly made up from an old razor blade. If one of the single edged, narrow blades cannot be had a double edged one may be clamped firmly in a vise and broken off. It will break clean and then may be mounted in a handle whittled from some fairly hard wood. The end of the wooden handle is split and the blade inserted, being bound in place with oiled thread of heavy size.

Large needles, to be used in picking up specimens, are *(Continued on page 92)*

STUDENT FLYERS TAUGHT FROM GROUND BY RADIO

Student pilots are now required to check their radio apparatus, left, before taking off. As part of their training, they must also prepare their set for installation, below, and they are responsible for its operation

Flying instructor using an ordinary telephone transmitter to give radio directions to his student flyers

Rookie flyer waves his hand to indicate radio message has been received

ROOKIE pilots, circling the Oakland, Calif., airport on their first solos, now hear the comforting voice of an instructor giving advice or encouragement by radio from the ground below. Student planes at the Boeing School of Aeronautics there are equipped with small receiving sets so student pilots can be coached from the ground during their initial flights. As the plane climbs into the air, the instructor plugs in an ordinary telephone, presses a button, talks into the mouthpiece, and is in communication with the plane.

Each time giving the number of the plane, to let the pilot know he is being addressed, he points out mistakes and aids the beginner in keeping out of trouble while flying and landing. Besides, he is able to warn of wind changes, bad visibility, and approaching storms when students are on short practice cross-country hops.

The receivers on the machines catch the voice of an instructor up to thirty miles.

Over the airport, the student acknowledges each message by a wave of the hand or by waggling his wings as, carrying only a receiving set, he can't talk back. To operate even a short range transmitter, a federal radio license is required. Consequently, the students are not permitted to carry sending sets aloft. Advanced formation flying is also being taught at the school by the radio method, several planes taking part at once. The amateurs fly tight formations, kick their ships into tailspins, and fly figure eights in response to radio commands. Instead of waiting until the students land to discuss mistakes, the instructor can point out errors as they occur and have the rookies go back over maneuvers until they get them right. Before every solo flight, the students must check the radio equipment.

CAMERA NOW CARRIES ITS OWN FLASHLIGHT

NEWS photographers now use a high-speed camera that provides its own flashlight. A socket built into the side of the camera, holds a flashlight bulb and batteries are concealed within the box of the instrument. As the shutter is snapped, electrical contact is made and the flashlight goes off.

BARREL POOL ON LONDON ROOF

CONSTRUCTED like an immense rubber barrel, an odd collapsible swimming pool on the roof of a hotel provides out-of-door bathing in the heart of London, England. The bathers enter the water from two platforms at opposite sides of the barrel pool, which is eighteen feet across and has a depth of about five feet. Heavy cables, which encircle the rubber container, are attached to uprights that serve as staves and thus hold the barrel in position. The unique pool, it is said, can be set up or taken down in a short space of time. It has proved popular and other and larger barrel pools are now being constructed.

Shaped like a barrel, this rubber bathing pool is in use on a London roof

Stretching Scales Test Road Rock

With this grinder, which has diamond edges, road rock is reduced to powder as the first step in testing it for use on the highways

Chemists take the rock dust and break it down with sulphuric or nitric acid so as to determine its exact chemical composition

Powdered rock goes into the forms seen below and is there mixed with sand and cement and dried into blocks before it is passed on to stretching machine for test of its tensile property

WITH "rock stretching" scales, with acids, and with electric grinders fitted with diamond edges, a staff of experts at the Los Angeles Testing Laboratory, in California, put samples of stone, to be used in street foundations, through searching tests. First, rock chemists grind samples to powder and then "break them down," by the use of sulphuric or nitric acid, into their chemical constituents. In this way, they determine the composition of the rock and its suitability for various types of construction work.

The second step is combining some of the powdered stone with sand and cement and placing it in "figure eight"-shaped molds to dry. As a test of tensile strength, these forms, when thoroughly dry, are placed in the "stretching machine." Two C-shaped jaws on the apparatus clamp over opposite ends of the figure-eight forms and pull in opposite directions. A meter on the device records the exact pull required to make the forms part in the middle. As the proportions of sand and cement are identical in all the forms, differences in tensile strength which the apparatus reveals are due entirely to differences in strength in the stone itself.

In this way, the testing engineers are able to determine the tensile strength of a particular chemical combination and to pick material best suited for foundation work on streets and highways.

From every truckload of stone delivered on a city job in Los Angeles, a sample must go to the testing laboratory for analysis before the rock can be used.

This machine pulls the rock in two directions while the dial records the amount of stress exerted before the rock splits

Wrecking Truck Carries Its Own Battery of Big Floodlights

Equipped with a battery of floodlights, this wrecking truck provides "daylight" at the scene of an accident

SUPPLYING current to a string of powerful floodlights, a new wrecking truck, recently tested at Buffalo, N. Y., speeds up work at the scene of an after-dark auto wreck. The battery of lights can be arranged in any desired position and can be switched on within a few minutes after the arrival of the truck. They illuminate considerable area, providing light-as-day working conditions for the crew. The car's regular batteries, which furnish the current, are powerful enough to run the lights for some time.

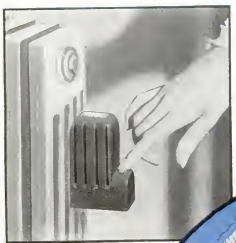
Helpful New Tools

KEEPS EGGS FRESH. This circular container is for eggs or fruit kept in the refrigerator. Its flat sides will not break the skins or crack the shells. Open spaces afford free ventilation that tends to prevent spoiling of contents

FLOUR SIFTER. With the double action flour sifter, cut out view of which is given at left, flour can be sifted as frequently as desired without removing it from sifter. The sieve is in the middle and there is a lid on each end

THERMOSTAT ON THIS HEATER. The combination electric fan and heater, above, has an automatic control that can be set at any desired temperature and the heater will switch on and off to maintain that temperature

TIMES YOUR COOKING. It is possible to set this electric timer for any period from one minute to two hours. A buzzer warns when time is up



CONTROLS THE HEAT. The valve shown above can be fitted to any steam radiator and when the dial is set, the desired temperature is automatically maintained. The new valve is installed by simply removing the old one, screwing the new one in place, and adjusting heat control dial

HOLDER FOR TOOTHPASTE TUBE. A tube of toothpaste or shaving cream, slipped inside this holder, is easily squeezed with a small lever which is effective until all contents are gone. A valve cap replaces the screw top, facilitating use of tube

AQUARIUM IN TABLE. Designed to match sun room or porch furniture, the table at right, has a built-in aquarium with a reinforced rim around the top. The edge of the tank is bordered with a trough in which flowers and plants can be grown as decoration

JAR TOP REMOVER. Saw teeth on the jar opener, below, adapt the tool to fit a large number of different sized tops. The handle grip makes use of opener unusually easy

for the HOUSEHOLD

CLOTHES SPRINKLER. A rubber hose, having a bulb and nozzle, is a convenient sprinkler. Bulb automatically fills itself

ELECTRIC MIXER. The tiny motor that runs this mixer is in the lid. A switch near it starts and stops the agitator in bottom of mixer

FIVE KITCHEN UTENSILS IN ONE. Many different kitchen tasks can be performed with the device illustrated above. It rices potatoes, strains or mashes fruit, is a flour sifter or a colander

PERFUME BURNER. Into the container, right above, perfume is poured. Top is put on, upper left, and connection made to electric socket. Heat forces out perfume vapor

A DOUBLE SHAKER. Two containers are joined together as shown above. In use, ice is put in the ice cage seen at left and the beverage poured over it. Container is then shaken a moment and then ice cage is lifted out and placed in container with handle. In this way, the melting ice keeps contents cold with no chance to dilute them

AN AUTOMATIC RANGE. The electric range, left, developed by Westinghouse engineers, does automatically many things the housewife has hitherto had to do. In cooking a roast, it first sears the meat at high temperature and then lowers heat to complete cooking and then automatically shuts off the current when roast is done

IRONING MADE EASY. The ironer, illustrated in circle, is designed to iron every kind of clothing to the housewife's satisfaction. It is operated by foot pedals so there is little danger of tearing the clothes or injuring the hands of the user

EXPERIMENTS IN

Electro-Chemistry

by Raymond B. Wailes

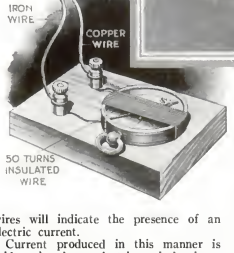
Fig. 2. With the apparatus shown at left, used as indicated in the photo above, it is possible to demonstrate the action of a thermocouple. Heating the copper and iron wire at the point where they are twisted together produces a current that can be detected with a galvanometer made out of a magnetic compass

BY ADDING some wire, several dry batteries, a magnetic compass, and a few other odds and ends to his home laboratory equipment, the amateur chemist can perform many interesting experiments in electrochemistry—that branch of chemistry dealing with electricity.

Like heat, electricity plays an important part in many chemical reactions and countless industries make use of electrochemical processes. Not only does electricity bring about chemical changes but many reactions produce electricity.

Visible chemical reactions, however, are not the only means of producing an electric current. A lump of sugar broken in two produces a faint blue spark that is visible in a darkened room. Similarly, rubber, celluloid, or amber rubbed with cloth or fur becomes electrically charged and will attract certain substances. This is mechanically produced electricity.

An electric current can also be produced by heat. This can be demonstrated best by twisting a copper wire and an iron wire together for a distance of about one inch. When the junction of the two wires is heated, a current measuring device connected to the free ends of the



wires will indicate the presence of an electric current.

Current produced in this manner is said to be thermoelectric and the junction of the two wires is known as a thermocouple. Because the amount of current produced is proportional to the amount of heat, thermocouples are used in laboratories for measuring temperature.

To experiment with the thermocouple, it will be necessary to obtain some sort of sensitive current indicating device. A simple galvanometer for this purpose can be assembled by placing a coil of about fifty turns of insulated wire around the case of a small magnetic compass in the manner indicated in the drawing above. In use, the unconnected wire coil is first rotated until it is directly over and parallel to the magnetic needle. Any current running through the wire will cause the needle to swing away from the coil to a point at right angles to its original position. For convenience, the coil and compass can be mounted on a suitable wood base and two binding posts can be supplied for the connections.

The fact that electricity can also be produced by chemical means forms the basis of the electric battery. A simple battery can be made by placing strips of copper and zinc in a dilute acid solution such as lemon juice or vinegar or in a simple salt or sal-ammoniac solution. The current produced by this battery can be detected with the galvanometer. A really practical battery of this type can be made by immersing a carbon rod and a zinc sheet in a solution of sal-ammoniac.

Batteries producing electricity by the action of a single solution on two electrodes of different metals is called a displacement cell or battery. Another type, consisting of two electrodes of the same metal placed in two solutions of different strength, is known as a concentration cell.

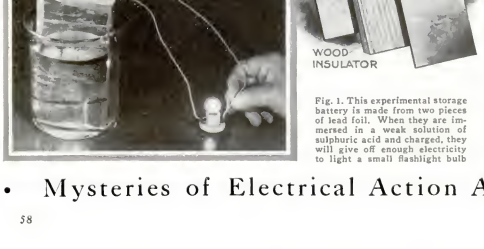


Fig. 1. This experimental storage battery is made from two pieces of lead foil. When they are immersed in a weak solution of sulphuric acid and charged, they will give off enough electricity to light a small flashlight bulb

• Mysteries of Electrical Action Are Revealed with

Fig. 3. This is an experiment in electrolysis. An electric current is passed through a sodium chloride solution and gas is produced which can be identified with litmus paper as chlorine

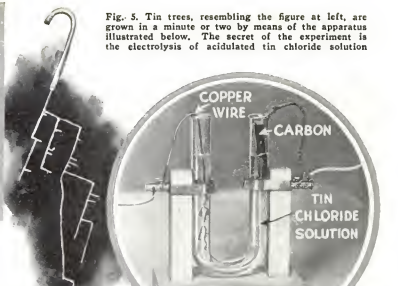


Fig. 5. Tin trees, resembling the figure at left, are grown in a minute or two by means of the apparatus illustrated below. The secret of the experiment is the electrolysis of acidulated tin chloride solution

A simple experimental battery of the concentration cell type can be assembled from a glass tube, a stopper, some copper wire, and two solutions of copper chloride of varying strength. Fit the stopper in one end of the glass tube and insert a copper wire through the stopper so that it projects an inch or more into the tube. Set the apparatus upright and pour in a strong solution of copper chloride, half filling the tube.

Mix a weaker copper chloride solution and carefully pour this into the tube so that it floats on top of the stronger and heavier solution. Insert a copper wire in the weaker solution and connect the free ends of both wire electrodes to the galvanometer. If the solutions have been carefully placed, the galvanometer will show the presence of electric current.

A sheet of blotting paper, moistened with vinegar and placed between a twenty-five cent piece and a penny, will also form a novel battery demonstrating the action of chemicals to produce electricity. The coins form the electrodes and when these are connected to a galvanometer a small current will be detected.

A model cell of the storage battery type can be made easily from scraps of lead foil and a small quantity of dilute sulphuric acid. Mount a sheet of lead foil, such as is used for wrapping tobacco or tea, on each side of a thin piece of wood, which is larger in area than the sheets of foil, and hold them in place with rubber bands. This unit is then immersed in a weak sulphuric acid solution made by mixing one part of the thick, strong acid solution with ten parts of water. Stir the solution with a glass rod and allow it to cool.

Your storage cell is now ready for charging. To do this connect a wire to each lead plate and run these wires to some suitable source of direct current. Dry batteries can be used, but better results will be obtained if a battery charger, such as is used for radio work, forms the current source.

As the current flows into the battery cell, bubbles will form at both plates, indicating the formation of a gas at each electrode. The gas at the negatively charged plate is hydrogen and that at the positively charged plate is oxygen.

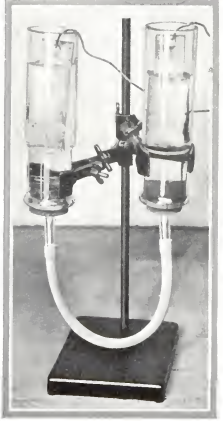


Fig. 4. How two olive bottles, rubber stoppers, glass tubes, and rubber tubing can be assembled to form a substitute for a U-tube

As the charging progresses, a chocolate brown deposit will form on the positive plate. Allow the battery to charge for several minutes more and then disconnect it from the current source. The battery is then charged and will light a small flashlight connected across the lead plates.

Contrary to the idea suggested by the name, a storage battery does not store electricity but chemical energy, which may be converted into electrical energy at will.

If desired, the acid used in this model battery can be poured off and used for other purposes in your laboratory.

The Edison storage battery consists of special iron and nickel electrodes immersed in a solution of some alkali such as potassium hydroxide. The home experimenter can duplicate this cell by suspending a strip of iron and a five-cent piece, which is composed mostly of nickel, in a lye solution. Copper wires soldered to the iron and the coin will serve as terminals for the cell.

Electrolysis, the process of breaking down a compound by passing an electric current through it, forms an interesting study for the amateur. A simple solution of salt in water, for instance, can be broken down by electricity and hydrogen and chlorine gases produced.

An ordinary mayonnaise jar forms an excellent container for electrolysis experiments in the home laboratory. Make a sodium chloride solution by dissolving ordinary salt in water, pour it into the jar, and insert two electrodes—one, a carbon rod, and the other, a strip of copper. These electrodes are in turn connected to the terminals of two dry batteries arranged in series—the copper strip being connected to the negative terminal and the carbon to the positive.

When the current flows, a steady bubbling at each electrode will be noticed, indicating the formation of gas. The gas coming from the carbon rod will have a pungent odor characteristic of chlorine gas. The identity of the gas can be definitely determined by the fact that it is a powerful bleaching agent. Litmus paper or colored cloths wetted and placed near the carbon electrode will soon lose every trace of color. Once recognized, however, the odor alone will be sufficient to allow you to identify this gas. The gas bubbling from the copper strip, which is connected to the negative terminal of the batteries, is hydrogen.

Salt, or sodium chloride as the chemist calls it, is composed of sodium and chlorine. It is the commonest of that group of chemicals classified as salts. In our experiments with solutions (P. S. M., Oct. '32, p. 55) we found that when an acid, a salt, or an alkali is dissolved in water, it will *(Continued on page 87)*

Simple Apparatus in Your Home Laboratory •

Grand Prize Winners

HEROES OF SCIENCE

Picture Cutting Contest

WINNERS of the Grand Prizes in our Heroes of Science picture cutting contest are announced here. The winners in this contest saved the extra parts from each contest from May to August inclusive and sent in their entries after the appearance of the August issue. An almost unbelievable number availed themselves of this opportunity and the judges were forced to work with the utmost diligence to determine the winners in time for publication in this issue. Great ingenuity, accuracy of information, and artistic skill were displayed by the successful contestants. Hundreds of those who failed to win a prize deserve favorable mention for the high standard of their efforts.

FIRST PRIZE $2,000

Phil Sapossnek, *Brooklyn, N. Y.*

SECOND PRIZE $500

Paul Kovacsik, *Akron, Ohio*

THIRD PRIZE $200

Paul Boniface, *Morristown, N. J.*

THREE $100 PRIZES

George Carnevale, *S. Ozone Park, N.Y.*
George Martin, *Camden, N. J.*
Ferdinand Sabatini, *Brooklyn, N. Y.*

TEN $25 PRIZES

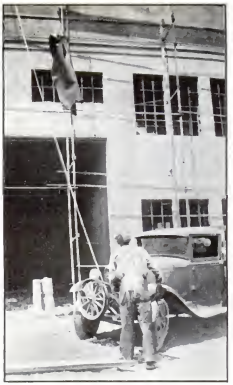
John A. Amato, *Bronx, New York*
Samuel M. Barnes, *Philadelphia, Pa.*
G. Carlson, *Los Angeles, Calif.*
Viola Crumby, *Memphis, Tenn.*
David Felzer, *Waukegan, Ill.*
Charles Gray, *Brooklyn, N. Y.*
Raymond Guerry, *New York City*
Charles Lind, *Hicksville, L. I., N. Y.*
Hans Passburg, *Longmeadow, Mass.*
R. B. Sandford, *New York City*

FIVE $50 PRIZES

James K. Hoffman, *Hempstead, N. Y.*
Irving Krum, *Philadelphia, Pa.*
Elwin Leslie. *Lakewood, Ohio*
C. W. Morgan, *Chicago, Ill.*
Charles North, *Glenbrook, Conn.*

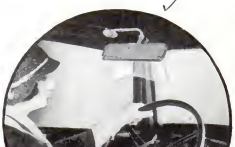
FIFTY $10 PRIZES

J. H. Anderson, *Lathrobe, Pa.*
Margaret B. Andrews, *Worcester, Mass.*
Elmer Benson, *Moline, Ill.*
William Blake, *Muncie, Ind.*
G. S. Blomme, *Wilmington, N. C.*
Walter Blume, *Washington, D. C.*
James H. Boyle, *Hamden, Conn.*
Frank Cannie, *New York City*
Letha Cleland, *Van Wert, Ohio*
E. Cowperthwait, *Philadelphia, Pa.*
F. J. Craig, *Andover, Mass.*
V. Deckert, *New York City*
W. F. Druzik, *Pittsburgh, Pa.*
L. E. Engle, *South Bend, Ind.*
R. B. Faris, *Lorain, Ohio*
A. Fieldbrave, *Christopher, Ill.*
L. W. Fuller, *Kansas City, Mo.*
C. E. Garlick, *Portland, Ore.*
G. M. Glassco, *Warren, Ohio*
J. C. Glore, *Atlanta, Ga.*
Weaver Harris, *Nashville, Tenn.*
Marye C. Hicks, *Chicago, Ill.*
Betty Howard, *Lincoln, Nebr.*
G. E. Hoyt, *Sioux City, Iowa*
Rose Julius, *Erie, Pa.*
Arthur Kalmbach, *Grand Rapids, Mich.*
R. La Fourcase, *Cleveland, Ohio*
L. J. Lambiase, *Brooklyn, N. Y.*
C. B. McCollister, *Wilmington, Ohio*
P. H. Miller, *Greely, Colo.*
W. L. Neuenschwander, *Akron, Ohio*
Margaret Parke, *Georgetown, D. C.*
R. H. Pool, *Larned, Kans.*
P. L. Potin, *New Orleans, La.*
Tasina S. Reddy, *Montclair, N. J.*
E. S. Rinehart, *Mersersburg, Pa.*
Mary L. Rowlette, *Muncie, Ind.*
Paul Schmidt, *El Paso, Tex.*
Margaret P. Schedler, *Fall Creek, Wisc.*
E. K. Shelton, *Pittsfield, Mass.*
W. R. Stott, *Memphis, Tenn.*
O. C. Swaren, *Chicago, Ill.*
Louis A. Tinari, *New York City*
G. Van Alst, *Huron, S. Dak.*
E. F. Wadley, *Jackson, Tenn.*
A. P. Warner, *New Haven, Conn.*
O. J. Weaver, *Cleveland, Ohio*
G. T. Welch, *Providence, R. I.*
Stephen Wieland, *Lytton, Iowa*
W. T. Wyckoff, *Belle Fourche, S. Dak.*



HOIST ON TRUCK MADE OF OLD AUTO PARTS

JUNK yard auto parts provided the material for an ingenious hoist which a Los Angeles, Calif., contractor rigged on a light truck to lift roofing materials during building operations. An old auto wheel with a wide rim forms the drum. A chain and sprocket, operating through an old transmission, applies power from the truck engine. The transmission gives three choices of hoist speed with one engine speed. The outfit was built for a small sum, is light, and yet will handle heavy loads. Placed at the front, it is out of the way when the truck is used for hauling.



NEW SHIELD PROTECTS MOTORIST FROM GLARE

AN ADJUSTABLE glare shield mounted on a swinging arm has been designed to protect motorists from late afternoon sun and approaching headlights. The device is attached in front of the driver's seat, five or six inches back of the windshield. Made of purple, transparent material, it can be moved forward or backward and tilted from side to side. The color makes it easier to see traffic lights.

THE FIRST OF A SERIES OF ARTICLES THAT TELL YOU

What Your Radio Tube Does

ALTHOUGH each year a seemingly new crop of radio tubes springs from the laboratories of the manufacturers, their bewildering technical labels refer in the most part to improvements rather than radical changes in the fundamental design. To the beginner in radio, the basic vacuum tube still is a glass bulb containing three essential elements—a cathode, a grid, and a plate.

Clearly to understand the first principles of modern radio, let alone the operation of the newer tubes, the amateur first must be able to picture what goes on inside a vacuum tube of the simplest design. Least complicated of all tubes, of course, is the early battery-operated type, but for the purposes of illustration the heater type of A.C. tube serves better since the current used to heat the cathode plays no actual electrical part in the circuit.

Physically, the general purpose heater tube (type '27) consists of three concentric cylinders surrounding a small heater or filament as shown in illustration at right. The cathode, a coated metal cylinder which when heated gives off negative particles of electricity called electrons, forms the inner cylinder surrounding the heater. Outside this is a coil of fine wire called the grid, and surrounding the wire grid is a larger metal cylinder known as the plate.

The heater, or filament, serves only as a source of heat for raising the cathode to the proper temperature and for this reason can be disregarded when considering the actual operation of the cathode, grid, and plate.

Let us suppose that by some magic we could stand inside a general purpose heater tube in operation. In the center, above our heads, we would see the red hot heater or filament used to heat the cathode which directly surrounds it. (In the illustration the plate has been folded back to show the construction of cathode and grid.) Could we see and identify electrical charges, we would notice a heavy cloud extending from the outer surface of the cathode toward the plate. On closer inspection, we would find that this cloud is composed of negative charges of electricity or electrons and that some of these electrons are leaving the cloud and rushing rapidly toward the surface of the plate.

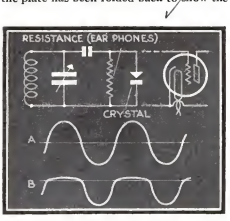


Diagram illustrating the rectifying or detecting action of a simple crystal detector

Like the negative pole of a magnet which is attracted by a positive pole, these electrons are attracted to the plate which, by outside wiring, is made positive. To get to the plate, however, they must pass through the fine wire coil or grid surrounding the cathode.

Let us suppose that by some outside connection this grid is made negative. Being thus charged it will repel the electrons rushing from the cloud surrounding the cathode and decrease the flow of electrons reaching the plate. Similarly, since unlike charges attract, a positive grid will attract the electrons and increase the flow to the plate. Thus when an electromagnetic impulse is applied to an input coil connected to the grid, the voltage on the grid is changed and causes a change in the current consisting of the electrons flowing from the cathode to the plate.

In its action the tube may be compared to a water system where the cathode is the supply, the plate the delivery end, and the grid a gate valve that controls the flow from the supply.

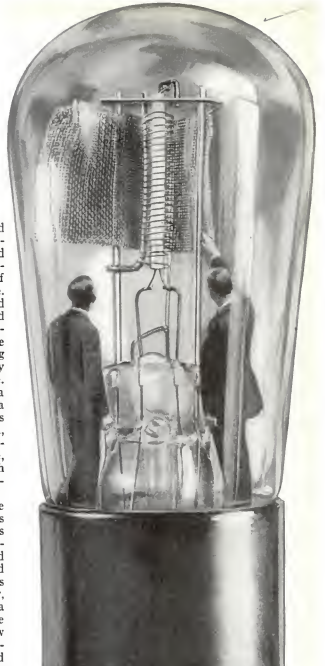
A vacuum tube operates as an amplifier because the variations in the plate current produced by the input voltage to the grid may build up much higher voltages in a suitable transformer, loud speaker, or head phones connected to the plate.

When used as a detector, the vacuum tube has a more complex function, since it not only serves to amplify but also eliminates one-half the carrier wave and allows the audio variations of the other half to be further amplified and finally transformed into an audible note.

To understand the basic principle of detection, consider the elementary crystal detector circuit shown at the left.

The action of the crystal detector is to allow current to flow in one direction only. When the current is flowing in the right direction, it will pass through the crystal instead of the high resistance of the head phones. However, when the current flows in the opposite direction, it cannot pass through the crystal so must pass through the head phones. In other words the crystal detector changes the incoming current from the alternating form illustrated at *A* to the uni-directional form *B*.

In the crystal detector, the energy supplied to the head phones comes directly from the signal energy and is merely changed in form by the detector. In the vacuum tube detector, however, the energy which is supplied to the head phones is derived from the plate battery and is merely controlled by the signal energy through the action of the grid.

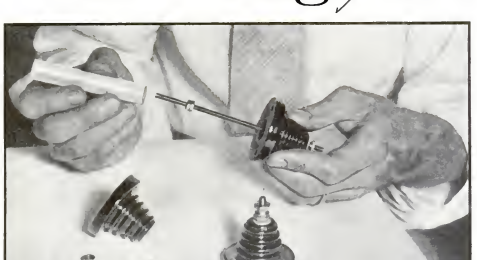


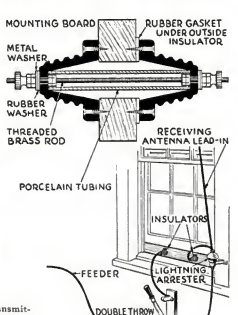
Standing inside a heater tube, we would see the red hot filament in the center above our heads

THIS is the first in a series of articles on radio for the beginner. The second article, describing the vacuum tube detector, is scheduled for early publication.

· *Final Steps for Amateurs in*

Getting on the AIR





1 An inexpensive entering insulator for the transmitting antenna feeder can be made from two stand-off insulators, a length of threaded brass rod, and porcelain tubing. Stand-off insulator in foreground. At right, drawing shows cross-section view of insulator

WHEN you have completed your short-wave receiver and transmitter and have obtained your Government license, you are ready for that long-awaited thrill of "getting on the air."

Although a single antenna may be used for both receiving and transmitting, bothersome switching may be eliminated and quicker two-way communication established if a separate, short receiving antenna is rigged at right angles to the transmitting antenna.

Careful insulation of the transmitting antenna lead-in where it enters the house is an important factor in the general efficiency of your station. For this purpose, a large variety of feeder insulators is available, ranging from inexpensive porcelain tubes of the type used in ordinary house wiring to more expensive bowl-shaped glass insulators used when it is desired to bring the feeder through the glass of a window pane into the reception room.

The amateur operating a small station, however, can assemble an inexpensive entering insulator from two stand-off insulators of the better grade, a suitable length of threaded brass rod, and a piece of porcelain insulating tubing. As shown in photo and diagram at top of this page, a separate hard wood board, placed between the jambs of the window in the manner of a removable screen or ventilator, serves as the mounting. The board should be about 8 in. high and 1 in. thick.

To assemble an insulator of this type, first remove the regular brass terminals from both insulators. Then mount one insulator directly over a ¾- or 1-in. hole in the mounting board and fit a suitable length of threaded brass rod with two sets of lock nuts as indicated. Next insert the rod, place the porcelain tubing over the rod, mount the second insulator on the other side of the board, and screw the terminals nuts in place. The porcelain tube should just be long enough to fit snugly between the stand-off insulators when they are in place (see sectional view).

For protection, your receiving antenna should be equipped with a lightning arrester while a single-pole, double-throw switch installed in the transmitter feeder will serve to ground that system when it is not in use. To prevent rain water, that runs down the feeder, from reaching the switch, place a U-shaped bend in the wire about a foot or more above the switch.

LOG

NO.	DATE	TIME	CALL	POWER	FREQUENCY	REMARKS

2 Above, suggestion for radio log as required by ruling of the U. S. Government

If you have selected the type of transmitting antenna that requires two feeders (P.S.M., Aug. '32, p. 65), it will, of course, be necessary to install two antenna switches, one for each feeder. Also, since both feeders must be parallel at all times and the same length, some system of keeping them taut must be supplied. This may be done by connecting both feeders to the antenna system in the manner illustrated in Fig. 3. The so-called "unconnected" feeder is attached to the system between two insulators.

Listening in on your short-wave receiver, you probably have learned that a definite procedure is followed when one amateur tries to get in touch with another. This procedure consists of repeating the identification letters of the station several times, sending the letters DE, meaning "from," and then the call letters of the station sending. In practice, this call is repeated four or five times and is followed by the letters AR, another abbreviation meaning the end of the message.

• Common "Q" Signals •

QRA ?..	*What is the name of your station?*
QRA ..	*The name of my station is* .....
QRI ?..	*Is my tone bad?*
QRI ..	*Your tone is bad.*
QRL ?..	*Are you busy?*
QRL ..	*I am busy.*
QRM ?..	*Are you being interfered with?*
QRM ..	*I am being interfered with.*
QRT ?..	*Must I stop sending?*
QRT ..	*Stop sending.*
QSL ?..	*Can you give me acknowledgement of receipt?*
QSL ..	*I give you acknowledgement of receipt.*

4 A typical continuous wave station operated by an amateur. Note neat arrangement of equipment and the absence of visible wiring

By JOHN CARR

Following a Definite Procedure Helps When You Reach the Thrilling Moment of Making Your First Call with Your Own Set to Far-Distant Stations

3 In two feeder system, both feeders may be kept taut by connecting them as indicated

Knowing perhaps only a few owners of short-wave stations, your first job as an amateur will be to make acquaintances through the air by listening for "CQ" calls. This call, which is used by amateurs when they want to talk with any station willing to make contact with them, is made by sending the letters CQ, the letters DE, and the call letters of the station sending.

Generally, the letters CQ and the call letters of the station are repeated three or four times and the complete call is sent for a period of three to five minutes. If you desire to make contact with a CQ'ing station, you listen for his call letters followed by AR and then call him back in the usual manner by calling his station and signing the call letters of your station.

According to a ruling of the Federal Radio Commission, every amateur must keep a complete and accurate record of the operations of his station. This log must include the time, the power, and the frequency for each entry of a station worked. A log book can be anything from a cheap paper-covered notebook arranged in convenient columns to an elaborate loose-leaf affair using prepared pages which can be purchased at most radio supply stores. Many amateurs even go so far as to maintain a convenient card file of all the stations worked, listing remarks that may be valuable for future reference.

Before the amateur does any actual transmitting he should familiarize himself with the many "Q" signal abbreviations that are used by radio operators the world over. These signals, constituting questions and their corresponding replies, consist of the letter Q followed by a combination of two other letters. If the Q signal is followed by a question mark (·—·—), it indicates that a question is being asked. If it is not followed by a question mark, it indicates that an answer is being given. Complete lists of abbreviations and Q signals are given at the back of most handbooks for amateurs. However, for those who do not have such a list, common Q signals are listed on the page opposite.

If it is necessary to keep your transmitter on the air while the station you are working makes adjustments use a repetition of the letter V. This is the common test call and is generally sent for a period varying from one to five minutes. If an operator wants you to send a test call, he will indicate it with the signal QRV.

Testing Your Condenser

OFTEN the radio fan, desiring to construct a receiver from scrap parts salvaged from old sets, finds that the variable condensers he has are not of the required capacity. If these condensers have a capacity greater than that desired, they can be made to serve merely by altering their construction.

The capacity of any condenser depends on the number and area of the conducting plates, the dielectric used between plates, and the distance between plates. Although altering any one of these conditions will alter the capacity, it is easiest, on a variable condenser, to reduce the number of plates. It is not necessary, however, to remove both the stationary and corresponding movable plates. Remove either one or the other until the desired capacity is obtained—the reduction being proportional to the number of plates removed.

A large fixed condenser can be tested by connecting it in series with a battery and a voltmeter. If the voltmeter shows a momentary deflection, the condenser is a good one. If a constant deflection is noted, the condenser leaks. If the full voltage of the battery registers, the condenser is shorted at some point.

5 Fixed condenser is tested by connecting it in series with battery and voltmeter. Momentary deflection means the condenser is a good one

A condenser can be tested quickly by placing it momentarily across the terminals of a battery. A pair of phones connected across its terminals will give a click if it is in good shape and known not to be short-circuited.

Anti-Freeze Problem

SOLVED BY FIRE AND BLAST

By Martin Bunn

A BRISK wind whistled an icy tune as Frank Gordon closed the radiator shutters on his car and started on his morning drive to his office.

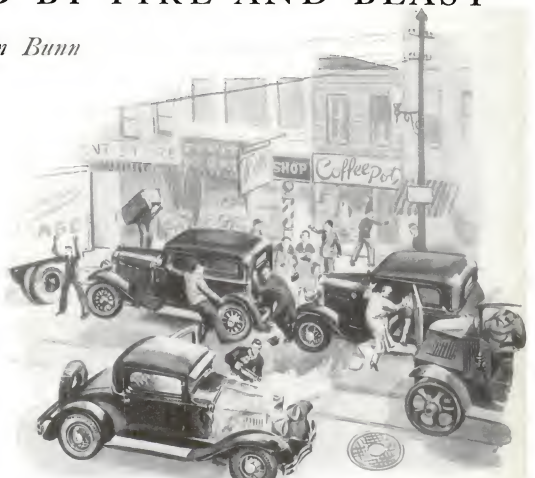
"Must be below freezing," he thought as he pulled his overcoat higher around his neck. "It's a lucky thing I put some alcohol in the radiator last night."

As his car hummed along the road, Gordon chuckled with self-satisfaction each time he passed stalled cars with steaming radiators. For once in his life he had outwitted the cold weather and put his alcohol in ahead of time.

Suddenly, as he neared the center of town, there was a blinding flash and a loud report. For an instant, the front of Gordon's car was a mass of flames. Dazed and frightened, he shut off the ignition and brought the car to a squealing stop.

Advice came from all quarters. Passing traffic hastened to get out of his way and shoppers excitedly tried to move their parked cars to safety.

Grabbing the fire extinguisher mounted under the seat, Gordon jumped to the ground and cautiously lifted the blackened hood. To his surprise, not a trace of the flames could be seen. Instead, water trickled from a long gash in the top radiator connection. The tongues of blue flame that had enveloped the hood but a moment before had died out as mysteriously as they had appeared.



For an instant, the front of Gordon's car was a mass of flames. Grabbing a fire extinguisher, he jumped to the ground and cautiously lifted the blackened hood

Completely puzzled, Gordon chanced driving the car the short distance to the Model Garage where he related his uncanny experience to Gus Wilson and his partner Joe Clark.

"And you say for an instant the front of the car was a mass of blue flames?" inquired Gus when Gordon had told as best he could just what had happened. "What've you been using in the radiator —dynamite?"

"Nope," Gordon replied, "just the old stand-by mixture of alcohol and water. But what's that got to do with it?"

"Plenty," barked Gus. "From the looks of this hose connection, pressure built up in your radiator. Something had to bust, and this was it," he declared.

Scratching his head, Gordon watched Gus pour water into the radiator. "But how can pressure build up in a radiator when there's an overflow pipe to let steam escape?" he asked, pointing to the tube in the radiator.

Gus said nothing, but continued to fill the radiator. He grinned when the water reached the top and spilled over the edges. Beckoning to Gordon to look down into the radiator he said, "The water's way above the top of that overflow now but it doesn't run off. In some way, that pipe's got clogged. Your motor heated up because you forgot to open the shutters and the alcohol boiled off and couldn't escape. After a while, the pressure got strong enough to blow right through the rubber hose and your hot motor—all soaked, too, with gas and oil—was sprayed with hot alcohol vapor. You're just plain lucky you didn't burn your car up."

"But how did the pipe get clogged in the first place?" inquired Gordon. "Dirt would have to be jammed in there pretty tight to stand more pressure than a rubber hose."

"It was ice that caused your trouble," Gus pointed out. "Some dirt probably got caught in there—rust or sediment from your cooling system. Then, when you filled your radiator, water collected over the dirt and froze solid. Have you ever tried to pry ice loose from metal by pushing it when it's frozen solidly?"

With a long piece of stiff wire Gus prodded the overflow pipe. "You see," he said, "now that the ice has melted it's easy to push through the dirt. Speaking of dirt," Gus added, "judging from the stuff that's come from your radiator I'd say it's pretty dirty. Ever clean it out?"

Gordon shook his head. "Never thought I had to," he replied.

"That's why your motor overheats," said Gus. "Dirt and rust form a scale on the inside *(Continued on page 110)*

GUS says:

Don't forget that your steering mechanism, brakes, tires, and headlights are just as important as your motor. It's nice to have a motor running smoothly, but if it suddenly fails, it won't put your life in danger. Check the major safety features on your car periodically and don't forget that the windshield wiper, horn, and stop light are important when you need them.

THE HOME WORKSHOP

By *Edwin* M. *Love*

With its vermilion body and yellow carriage, this tiny model of the *Diamond Tally-Ho* is a beautiful ornament, whether standing alone or set on a box

A unique new way to solve your Christmas gift problems without spending much money for materials

MAKING *Miniature* Coach Models

GIFTS that carry with them something of the personality of the giver and are at once unique, beautiful, and inexpensive can be made by taking advantage of the present vogue for coach models and building tiny miniature coaches. These may be used either as ornaments in themselves, as decorations for boudoir boxes, or as cigarette containers.

Any coach model plans will give data on which to base the miniatures. To ornament the glove box shown in the photograph at the left above, I chose the *Diamond Tally-Ho* from the POPULAR SCIENCE MONTHLY series of models, and for the cigarette container illustrated at the bottom of the page, a somewhat larger model of a covered wagon. Because of the possibility of their being roughly handled, some of the parts are enlarged in scale; but the general proportions are accurate, and the little boxes, tinged as they are with the glamour of the old West, are genuinely beautiful.

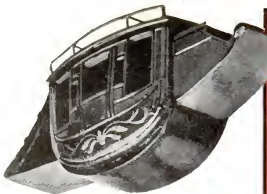
Cigarettes are ejected from the end of this covered wagon

The stagecoach model, too, if made a little larger with the window openings covered inside and the top removable, can be used as a jewel or match box; and, of course, the covered wagon, somewhat reduced, could be mounted on a little chest. The "Buffalo Bill" Cody type of coach, by the same methods, would work out well.

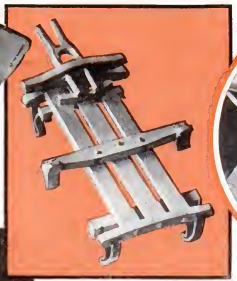
When building the *Diamond Tally-Ho* miniature, rough out the parts from close-grained hardwood, and trace the shapes on with carbon paper. The center of the body, together with seats and boots, is jig-sawed from one piece of wood, the ribbed upholstery being indicated by narrow grooves. As the dashboard projects beyond the fore bootsides, the driver's seat and boot floor are recessed at the sides, where pieces of thin celluloid, cut from old photographic negatives, are glued on with household celluloid cement to represent the leather sides.

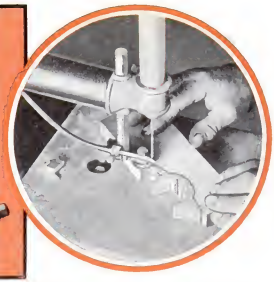
After cutting the body sides, scribe guide lines on the edges and carve the vertical curve, then the horizontal, finishing all smoothly. The outsides can be roughed on a sanding disk in short order, and the insides hollowed with a sanding drum, if machinery is available. The paneling is outlined with grooves.

Make the top slightly crowned, hollow it lengthwise inside, and fit it to

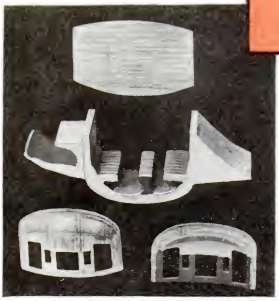


The finished coach body. It is attached to the carriage with small, thin nails and pins





The underside of the carriage is shown in the rectangle. The wheels are fastened on with No. 18 brads. *In circle:* The jig-sawing can be done either by hand or machine



The parts of the coach body. These may be cut from any close-grained hardwood. Note how the upholstery and roof battens are indicated by fine grooves

the sides. Cut thirteen grooves on top to simulate protective battens.

The three reaches are made individually, but the fore bolster and axletree are jig-sawed from one piece, with a groove dividing the two. Drill the bolster to receive pins for attaching the reaches, and bore 1/16-in. holes in the axletree to receive the hound side arms.

The hind bolster and axletree, supporting the hind brackets, are separate pieces. A straight cross member above the reaches behind the fore bolster carries the fore bracket braces.

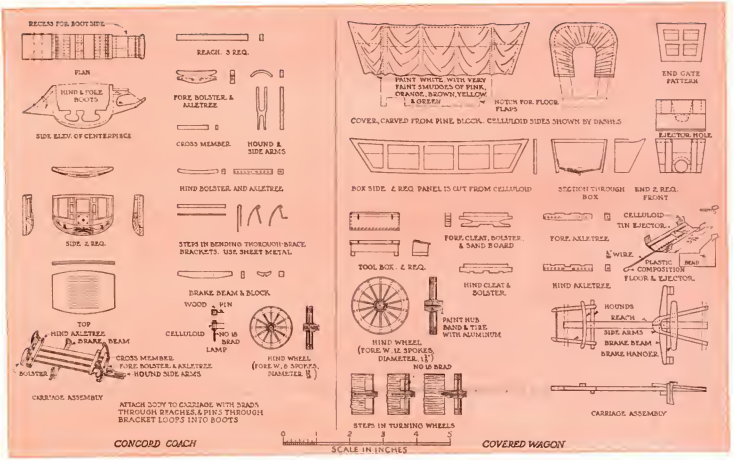
Assemble the hind axletree, brake beam, and cross member with the reaches, gluing the joints and strengthening them with pins driven in holes drilled to receive them. Add the bolsters and hound parts.

Thin sheet metal is used for the thorough-brace brackets, which are bent to shape with pliers. I used steel hair curlers, and drew the temper by heating the material red-hot. Celluloid cement in itself is sufficient to hold the brackets in shape.

Before assembling the body, paint the upholstery, floor, and interior below the windows light green. Above, use dark vermilion of the shade to be used outside.

If necessary, after the body is put together, work off the edges of the top to follow the curve of the sides, for the edges project only 1/32 in.

To represent the folding of the boot cover over the hind boot sides, cut celluloid



Working drawings of both the stagecoach and the covered wagon. The dimensions of every part can be found easily by reference to the inch scale

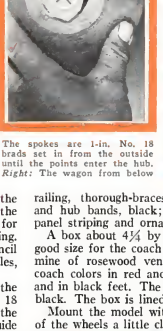
Right: The covered wagon with the top removed. False bow ends are fastened to the box sides to match those on the top itself, which is carved from soft pine

Left: Turning a wheel blank in the lathe. A recess is cut for the spokes, which are inserted later through holes drilled in the rim

strips to be cemented on. The four cardboard straps—two on each side—lap over these.

Recess the forward underside of the fore boot and dash to give the effect of cleats. Cut celluloid to extend a little above the seat and paint the insides black before assembly. The end seat aprons appear as cardboard strips glued to the boot sides.

The wheels can be turned and built up with brads for spokes more quickly and easily than by other methods, and this construction is very rugged. Attach to a lathe faceplate, either with screws or a wooden chuck turned to receive it, a block of soft pine about 2 by 2 by 4 in. Turn to the diameter of a wheel, and sand. Then, working from the face, shape the hub and turn the felloe, recessing deeply for the spokes. Leave a little stock inside the felloe for turning off after drilling for the spokes, thus erasing any splintering. Also drill the spindle hole. Scribe a pencil line on the tire to center the spoke holes, with a similar line on the hub.



The spokes are 1-in. No. 18 brads set in from the outside until the points enter the hub. *Right:* The wagon from below

Remove the faceplate from the lathe and drill the felloe holes with a No. 18 brad. Insert 1-in. brads, thrusting the points lightly into the hub, on the guide line or beside it, according to its chance position as established by the first spoke, with due regard, of course, for dish in the wheel. Tap each brad lightly with a hammer to force the point into the hub, cut off the projecting head, and drive the end flush. Then replace the work on the lathe, turn the felloe loose from the block behind, and shape the inner end of the hub. It is now ready to be cut off.

When all the wheels are made, fasten a block of wood to the faceplate and turn a depression ⅛ in. deep and large enough to take a small wheel when pressed firmly in. Insert the wheel, outside in, and dress the felloe to form the tire projection. Finish the other fore wheel; then enlarge the chuck to take a hind wheel.

Use 1/64-in. stiff brass wire for the top railing, soldering it at points of contact.

A glass bead or a box made from clear celluloid, topped off above and below with wooden caps, will serve for a lamp.

For painting I used quick drying enamels and varnish, applied with a ¼-in. flat sable brush and a 1/16-in. round brush. The body, boot floors, and driver's seat aprons are red; boot sides and cover, lamp frames, railing, thorough-braces, brackets, tires, and hub bands, black; carriage, yellow; panel striping and ornaments, gilt.

A box about 4¼ by 9 by 3⅜ in. is a good size for the coach mounting. I built mine of rosewood veneer, repeating the coach colors in red and gilt stripe inlays and in black feet. The coach platform is black. The box is lined with blue velvet.

Mount the model with the lower edges of the wheels a little closer together than the upper. Scrape off enough paint to make wood-to-wood contact between the box and each wheel, so that glue can adhere. Reënforce with a wire looped over the felloe and twisted under the platform.

The general construction of the covered wagon is self-evident. The cigarettes fill the wagon and are removed one at a time by pulling the ejector knob in the front end of the box near the bottom. This draws out a cigarette through the hole immediately above the knob. If preferred, of course, the "canvas" part of the top, which is really wood, could be hinged to the wagon box—a better arrangement for the many smokers who are prejudiced against semiautomatic ejectors of any kind.

The bottom of the container is a celluloid trough supported underneath by cross strips, which have their flaps cemented to the sides of the wagon body. Carve the top from a pine block, and fit the sides against the irregularities of the lower edges. False bow ends are glued to the sides.

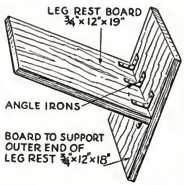
Mount the wagon on a base 3½ by 6½ in. Paint the cover light ivory, with faint tints of other colors here and there, and antique the rest by painting it dark gray over which red poster paint is coated, with yellow ochre in the joints. When dry, scrub over with a stiff brush, and give one coat of varnish thinned with an equal amount of turpentine. Indicate weathered grain with streaks of flat Vandyke brown, and use this color in the cover openings and on top of the box ends.

To load the box, remove the top, invert, and fill with cigarettes. Close the box in the same position; then set it upright.

Comfortable T-Shaped Leg Rest Is Self-Adjusting

This leg rest is better than a footstool because it supports the legs at any desired angle, no matter how far one wishes to stretch out while lounging in a chair. Only two boards are needed for making it

MEN who like to stretch out in their favorite chair with a newspaper or magazine will find a leg rest of the type illustrated surprisingly comfortable because it adjusts itself to any angle. Two boards, four or six angle irons, a few nails and screws, a box of tacks, and some strips of carpet or other covering are all the materials required.



The framework is made from boards about ¾ in. thick and 12 in. wide. Almost any wood can be used; in fact, common yellow pine is suitable. The board used as the end support or base is 18 in. long and the other board, 19 in., but the latter can be made shorter or longer as desired, depending upon the length of the user's leg from heel to knee. The leg rest board is then placed at right angles to the baseboard in the center and nailed. Two or three angle irons are attached on each side to make the frame rigid.

To cover the wood, strips of carpet are cut out, sewn together, slipped down over the leg rest board, and tacked to the baseboard. Other strips are then tacked over the baseboard section. In the absence of carpet, other upholstery materials could be used.—IRL GORDON.

WISTFUL PUPPY HOLDS CIGARETTES

THIS wistful looking puppy catches the eye of everyone because of his melancholy countenance, but he is really a very useful animal. He holds cigarettes, matches, cards, or any small articles. His body consists of a box closed at each end with pieces cut out to represent the shoulders and haunches of a dog. The cover extends over at the rear to form a tail and, incidentally, a handle.

The inside dimensions of the compartment are 4 in. long, 2¼ in. wide, and 1¾ in. deep. The over-all dimensions are, from tip of nose to tip of tail, 9 in.; height, 7½ in.; width, 4 in. The head is fastened to the body with a single screw. The eyes are pushpins enameled white.—K.M.

The puppy's tail is a convenient handle for lifting off the top of the cigarette box, which is 4 by 2¼ by 1¾ in. deep

The head, held by a single screw, may be tipped mournfully to one side

AN AID IN TOENAILING

SMALL, light pieces of wood that have to be toenailed in place always have a tendency to slip, but they can be held just where you want them with the aid of a common, heavy rubber door wedge. The soft rubber will not slip, and it keeps the piece squarely in place.—F.W.B.

OCTAGONAL RODS PLANED QUICKLY ON JOINTER

WHEN it is necessary to plane a square stick to an octagonal shape on a jointer, first set the fence at 45 deg. and bevel the edge of a piece of waste 1 by 3 in. stock. Clamp this guide piece against the fence as shown to form a trough in which the work can rest with no tendency to turn over. Take one cut at a time on each corner. One stroke over the jointer will finish each corner of a small rod.—E.L.

EASY MATCH TRICK BAFFLES ONLOOKERS

KNOWN as the "strike-out match trick"—a bit of magic that seemingly depends on pure skill—this simple little stunt is aptly named: it always "strikes out" anyone else who tries it. A box of safety matches rests on the back of the hand, and a single match is held between forefinger and thumb. A toss sends the box into the air. At the same moment the performer lights the match by striking it on the rapidly falling box. He never misses, but others trying the stunt always do.

Cut out a small square of the striking surface from another box and smear the back with a sticky substance scraped from warm adhesive tape so that it can be fastened firmly to the palm of the hand. With very little practice you can manipulate the match so as to strike it on the palm at the moment the hand touches the falling box. The rapid movement of the hand makes it impossible to detect this bit of trickery.—GEORGE S. GREENE.

How the match box and match are held before the box is tossed into the air with a flip

As the box falls, the performer actually lights the match on a tiny striker stuck to the palm of his hand

Added Seat Allows Two Children to Use Toy Auto

The method of making the seat is shown above and the actual installation appears in the photograph

Every boy who owns a toy auto will have much more fun playing with it if it is equipped with a homemade rumble seat so that he can take a little friend along to keep him company. As shown in the drawing, it is best to make the rumble seat as nearly as possible a duplicate of the original driver's seat of the toy car.

The extension is supported in cantilever fashion on two strong hickory seat rails inserted into the steel frame channels of the car and fastened with bolts. A sort of tin box is provided for the youngster to rest his feet in, well protected from the cranks of the rear axle shaft. The exposed edge of the tin that forms the back of the seat is beaded around a piece of No. 9 wire. This bead is made with pliers and a ball pein hammer while the sheet metal is still flat. The corner bends are made afterwards. Avoid any square corners or sharp, tinny edges that might cause injury in case of a spill.

After the seat has been strongly screwed and bolted together, it should be given two coats of auto enamel.—Stewart Rouse.

QUICK DRYING GLAZE FOR CARDBOARD

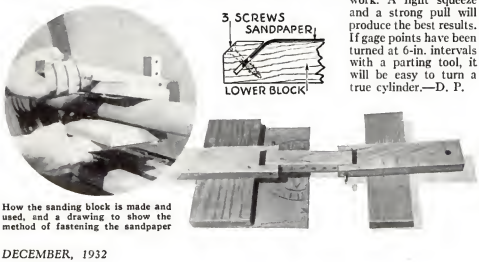
A velvet gloss finish or glaze can be given sheets of cardboard and similar materials with a solution of sodium silicate or water glass. The process is a simple one and takes so little time that it can be used for many purposes for which a more expensive finish would not do.

To each pint of the solution add one teaspoonful of pure glycerine and mix thoroughly. Apply a small quantity on the cardboard with a brush, and immediately smooth it out with a rubber roller so that it forms a thin film. The finish dries in ten seconds and can be handled at once. The illustration shows the application of the compound to the face of a penny picture post card in order to make it look more like a photograph.—V.B.C.

CLAMP FOR SANDPAPERING CYLINDERS

In turning a true wooden cylinder of exact diameter—no easy feat for the amateur—the use of coarse sandpaper held against the work between two blocks of wood is a great help. The sandpaper holder illustrated is a development of this method.

The pressure blocks are of straight 13/16-in. material 9 in. long, the upper one about 3 in. wide and the lower about 4½ in. wide. They are screwed to 13/16 by 2½ by 8 in. handles, and these are connected by a 13/16 by 1 by 6 in. link, which has ¼-in. holes bored at ¾-in. intervals for metal pins—in this case ¼-in. cotter pins. The sandpaper, of coarse grade, is clamped in the front edge of the lower block, as shown in the drawing. The pins are so adjusted that the handles are not quite parallel when placed on the work. A light squeeze and a strong pull will produce the best results. If gage points have been turned at 6-in. intervals with a parting tool, it will be easy to turn a true cylinder.—D. P.



How the sanding block is made and used, and a drawing to show the method of fastening the sandpaper

DRILLING JAMMED LEAD OUT OF A PENCIL

Leads sometimes jam in automatic pencils. Several times I paid a jeweler to drill the lead out before I discovered that a simple but effective little drill could be made at home from the wire of a medium sized paper clip, which is slightly smaller than the lead in an ordinary automatic pencil.

Take one of these clips and straighten out the first and second bends of the long side, leaving the short side bent to act as a handle. Flatten out the tip with a file or by striking it with a hammer on a hard surface. Insert this tip in the end of the pencil and turn with the fingers, using it as a drill. If the wire is removed at intervals and the dust poured out, it will be found that the jammed lead can be cleaned out quickly and effectively, leaving the pencil practically like new.—W. G. Hammond.

A straightened-out paper clip is used to remove the lead

DUAL SANDING ROLL

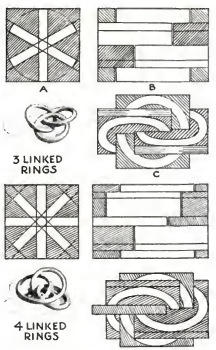
When finishing pieces on an ordinary wooden sanding roll of the type generally used in the lathe, it is vexatious to have to stop and change from coarse to fine sandpaper. To obviate this, turn the roll with a raised bead or ridge in the center, dividing it into two halves. Fasten the coarse sandpaper on one half and the fine sandpaper on the other half. The bead prevents accidentally scoring a nearly finished piece by moving it onto the coarse sandpaper, yet both coarse and fine sandpaper are available.—C. F. Blake.

HOW TO WHITTLE INTERLOCKED RINGS

HERE, whittlers, is a test of your skill. Can you cut one block into three or four rings, each linked into the others?

Better practice with three rings first. All you need is a small block of mahogany or walnut, 2 by 2 by 3 in. Mark on both ends as shown at *A* and cut away all of the shaded parts. Now mark it as at *B* and again cut away the shaded parts, leaving a figure like the one shown at *C*, as if three thin rectangular pieces were set at an angle so that they project halfway through each other.

Cut out of cardboard or thin sheet metal a template for marking the three circles. With a small, sharp chisel carve away the corners outside the circles. Next cut away the inside of the rings, but be very careful not to cut into the rings. Look as often in back of the work as in front. When the rings have been cut free from



Steps in cutting the rings and photographs of the three- and four-ring combinations

one another, round them nicely with a chisel and smooth them with sandpaper. Stain and shellac them if desired.

Next try the four rings. You will need a block 2 by 2 by 3⅛ in. Proceed as with the three rings, but be careful to have ¼ in. between the two outside rings where they cross each other, because this allowance will make it easier to cut them apart.—WILLIAM HARVEST.

WOODEN LETTERS SPELL CHRISTMAS GREETING

LIGHT, fragile pasteboard letters are not altogether satisfactory as part of the Christmas decorations. Heat, cold, and changing conditions of moisture frequently make a sorry mess of them. It is better to use the neat toy wooden letter blocks that can now be so inexpensively obtained. These are coated with gilt paint, and small screw eyes are inserted in the top so they can be strung on string or picture wire. This is then concealed with a colored streamer.—F. B.

Part of a "Merry Christmas" sign made by hanging gilded wooden letters on a string

MUSLIN COVERED FRAME AIDS IN BENCH WORK

IF YOU have to repair or assemble a model or any mechanism having many small, delicate parts, try this method of preventing any of them from being dropped and lost. Make a frame the depth of your bench and 18 or 20 in. wide. Cover the front two thirds with muslin, fastened securely but not pulled tight; it should bag a little. Fit slides under the bench top for the frame. When handling small parts, pull out the frame so that the cloth will catch anything you drop.

RACE TRACK GAME MADE ON JIG-SAW

DROP a ball into the entrance hole of this homemade race track game, let fly the trigger, and the ball spins around the track. Five steel ball bearings are allowed each player, and there are twenty-six pockets in which each ball may come to rest, providing it does not hit one of the "traps."

Figure 1 shows the shape of the board and how the center is removed at a 20-deg. angle on the scroll or jig saw. The "traps" are brass nails staggered on the slanting track as in Fig. 2. The cut-out board is glued to another board of the same shape in which ½-in. pockets are bored as in Fig. 3. A small disk is then glued in the center and a narrow flange placed around the rim of the track so that the balls cannot jump out.

The trigger is like those used in marble game boards.—K.N.

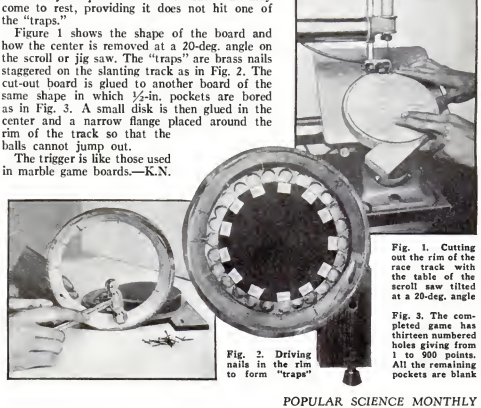


Fig. 1. Cutting out the rim of the race track with the table of the scroll saw tilted at a 20-deg. angle

Fig. 2. Driving nails in the rim to form "traps"

Fig. 3. The completed game has thirteen numbered holes giving from 1 to 900 points. All the remaining pockets are blank

Captain McCann with his model, which is run by a storage battery and electric motor

Now we tackle the DECK FITTINGS of our new

Battleship Model U.S.S. TEXAS

A view of the superstructures, deck fittings, and forward turrets. Note the casemates cut into the upper part of the hull

By *Capt.* E. *Armitage* McCann

MOST of those who read last month's article on the U. S. S. *Texas* (P.S.M., Nov. '32, p. 67) and intend to build our new 3-ft. model of her—she is flagship of Battleship Division I of Battle Force, U. S. Fleet, and was long famous as flagship of the Atlantic fleet—will construct it for exhibition purposes. For those, however, who wish to make a working model, a few suggestions in regard to the power plant should be added.

If an electric motor is to be used, it is well to gear the speed down to about one third. For this a 3/8-in. spur gear (cog wheel) on the motor shaft and a 1 1/8-in. gear on each shaft will serve. Put the 3/8-in. gear on and lay the other two on the bedplate so that their teeth engage each other but only one engages the small gear. They will therefore turn in opposite directions, either above or below the center shaft. Drill 1/4-in. holes at these positions. Turn up the bottom of the bedplate to a little less than a right angle so that gear wheels and motor are clear of the bottom, and drill it for wood screws. Now bring up the shafts to go in their holes. Fasten down the motor, noting that for the shafts to be parallel the motor will be slightly to one side and tilted towards the stern. It will go at the rear end of the opening which is to be cut as shown in the deck.

Get the tubes accurately in line so that the shafts turn quite freely, and fasten them there, leaving about 7/8 in. projecting outside and filling in between them and the hull. The inner ends of the shafts should be threaded for nuts or have holes drilled for wire cotter pins. The gears are either soldered or keyed to the shafts.

The outside ends of the tubes should be filed quite flat and smooth, and the small pieces previously cut off are bored inside to a conical shape so they will engage the ends of the tubes and act as stuffing boxes to keep the water from entering. Solder these in position when the gears are engaged and the inner ends of the shafts run free in their bearings. Cut off the outer ends of the shafts to the right lengths so that the propellers will not quite touch the struts and their centers will be in line with the rudder trunk. This latter is important to allow the rudder to swing.

For a switch, I used a small revolving car switch and placed it in the second barbette with the end projecting through the turret, where it looks like a ventilator. The wires lead through the deck to the battery and motor.

The bilge keels may now be fitted. The position of these was indicated on the sheer plan last month. It will be noted that there are two short ones on each side. I cut mine from sheet brass, leaving a long prong at each end as shown at *G* in the drawings on page 72. A knife cut is made along the hull in which to fit them, and a cut is run right through for the prongs, which are bent up inside. They should be 1/4 in. wide, although I gave mine an extra 1/4 in. for stability. Although actually straight, they form a stream line when on the hull.

Before putting the deck lift back in position, a hole must be cut in it to get at the machinery (for a working model). The area of this can conveniently be made just a little less than the upper deck and engine-room fiddley. I cut the opening with a fret saw, held at a slight angle, to the line shown on the deck plan. If cut with a fine saw, this joint, considering the overhang of the deck above, will be sufficiently tight. I then cut away the waste as indicated by the inner line, to save weight. This rim later will be glued to the upper deck and will lift out with it.

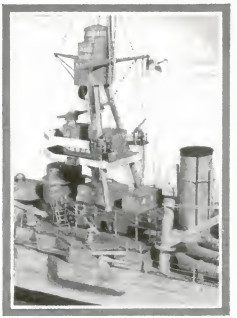
The deck lift should now be glued and nailed on, the position of all the fittings marked, the casemates in the sides cut, and the projecting midship wing pieces *J* cut and fastened.

The rudder *H* (shown last month) is next added. The post is a piece of 1/4-in. rod, for which a hole is bored through the skeg and up through the deck. The lower end is cut down the center, and the sheet brass rudder is placed in position through the slot in the post and soldered. To hold it in any position, as is necessary with a working model, I threaded the top end and on it fitted a little capstan *(64)*. If it is not to work, then shift the capstan to its right position just forward of station line No. 9, and do not bring the rudder-post through the deck.

The hawse pipes should be large enough to take the shanks of the anchors—about ⅛ in. Make small holes first and bore up and down to get both ends at the right position. The hawse pipe lips can be rims of brass tube or be fashioned from plastic material. The upper ends *(3)* can be of similar material or brass plate. It will be noted that there are two anchors on the port side and one on the starboard. The anchors themselves should be of the Navy (stockless) type as shown in detail *62*. They may be purchased or made from lead or brass. The cables should be black chain with about 11 links to the inch.

The towing collars *(2)* are 3/32-in. holes cut through the hull at the deck level, the upper part of the rim extending above the deck level. They are made of plastic material or of brass tube filed to shape.

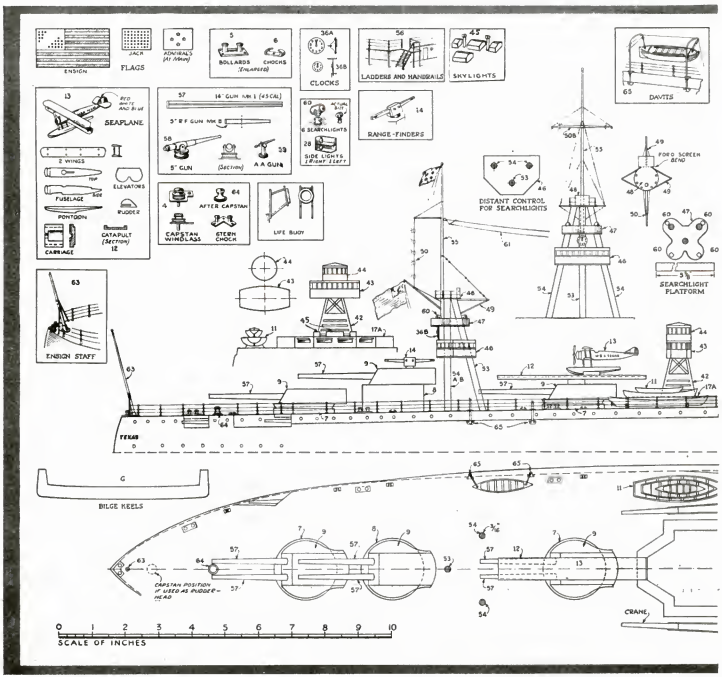
The three capstans should be turned from brass or wood to the shape shown at *4*. The lower part is in reality a gypsy to hold the chain as the capstans turn; this can be disconnected and the top used for a rope. They work on beds in which there is a hole (chain pipe) through which the chain goes below. After putting the chains down, I closed the holes with plastic material to look as if they had covers on.



Foremast with plotting and radio rooms, pilot house, control stations, and battle tops

The deck should be lined to represent deck planks before putting anything on it. I do this with a very sharp, hard pencil and straightedge. Lines about 1/16 in. apart look best.

The lower bridge houses (captain's quarters) and upper deck *17* are cut from a piece of ½-in. wood. The deck should be plank-marked. The three casemates on each side are cut, and the portholes and doors are indicated as in the drawings. For portholes on this model, I sharpened the edge of two pieces of tube of the right size—1/16 in. for the outboard ports and 3/32 in. for the inboard—and lightly tapped these in the wood to make circular indentations, afterwards painting the rims and filling the space inside a light blue color. The model undoubtedly would look better, however, with real air ports, either made or bought. There are 36 large and 146 small. I just painted on the doors and windows.



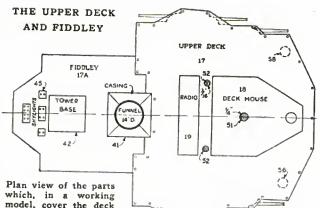
On this deck there are two nouses *18* and *19*, also cut from ½-in. wood. They should be painted before the deck above is set in place.

The next bridge deck *(20)* I made from 1/16 in. fiber board, but 24-gage brass would have been better, because with it you can have the stanchions closer to the edge and solder them in position, if necessary. Its shape will be seen in the detail. It should be drilled for the stanchions before being placed. On it goes the conning tower support *(21)*, a little deck *(22)*, and above that the conning tower *(23)*, which instead of ports has narrow slots and three small ventilators on top. Abaft that are the plotting room *(24)* and the radio room *(25)*. All these are cut to shape from ½-in. wood.

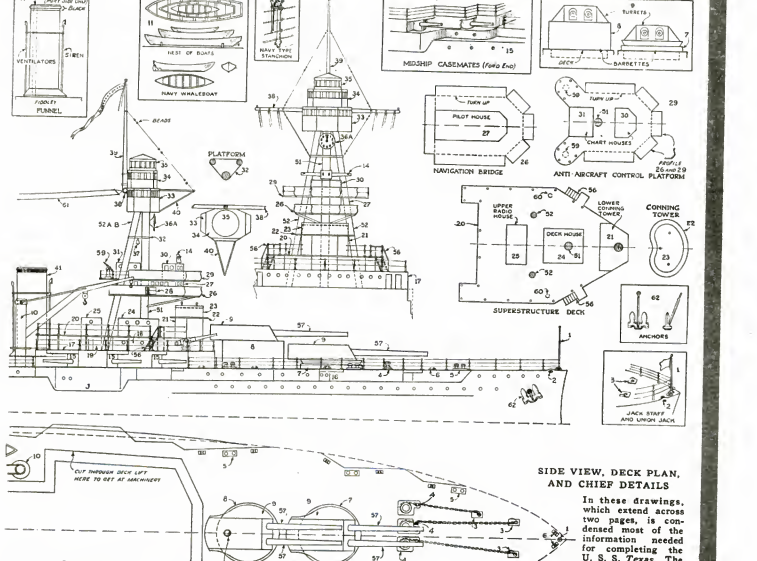
Next we have two flying bridges made from 28-gage sheet brass cut to the shape shown in details *26* and *29*. The edges are turned up and soldered at the corners to form weather screens. The wing extensions of *29*, however, have stanchions instead of screen, as shown. For these the deck is bored and the stanchions put in, the ends being cut off short and fixed with a touch of solder underneath. The edge of the screen should have holes, and in the corner of the house there should be staples to which some No. 33 wire is fastened and rove through the two-ball, ¼-in. stanchions. Around the front part, the screen is peculiarly shaped to form a wind shield; this can be indicated by fastening on carved plastic material or wood.

On the lower of these decks there is one house *(27)* and on the upper two *(30, 31)*, and on *30* again is a range finder, the construction of which will be found in detail *14*.

Each of these decks and houses *(27, 24,* and *18)* needs a ¼-in. hole through which the vertical part of the tripod *(51)* will pass, and the three decks require 3/16-in. holes for the after struts *(52)*. These must be carefully bored. The tripod may now be erected. The best way to fix the legs at the top is to cut a piece to the shape of the main battery control station *(33)* about ⅛ in. thick and nail this onto them. Reduce the depth of *33* by a like amount and glue it on.



The description of the deck fittings will be continued in the next issue.



SIDE VIEW, DECK PLAN, AND CHIEF DETAILS

In these drawings, which extend across two pages, is condensed most of the information needed for completing the U. S. S. *Texas*. The side view and deck plan correspond in scale to the plans for the hull alone, published last month

For the man who likes to make unusual Christmas Gifts

A COSTLY LOOKING

Bridge Set Holder

It is constructed of two finely figured woods and has bright metal handles

By DONALD A. PRICE

The distinctive design and fine materials give it an expensive look

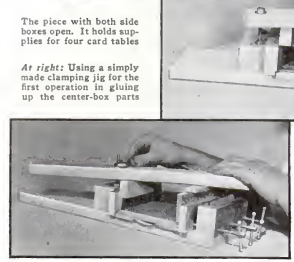
DELICATELY patterned, amber colored lacewood against a background of somber-hued rosewood and gleaming metal handles—this is the combination of materials that gives distinction to the bridge set holder illustrated. It is an attractive and practical case for keeping handy the cards, score pads, and pencils required for four tables of bridge. As a Christmas gift, it has obvious advantages; and while it looks expensive, the cost is low, especially if several of the holders are made at once and the price of the small amount of necessary materials is divided among them.

The work resolves itself into making three boxes, fitting them together, forming the metal handles and catch, and finishing the wood in an appropriate manner.

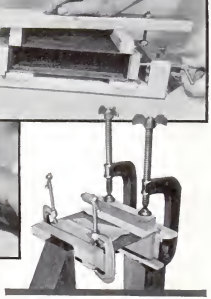
In preparing the parts of the boxes, especial care should be taken to get them square and accurately cut to the dimensions shown on the drawings. The cutting out and rabbeting can be done entirely on a small circular saw, if available. To insure uniformity, trim the parts that fit together at one setting of the saw. For example, the tops, fronts, and bottoms of both side boxes should all be cut to length at one time. The rabbets on these parts may be made *(Continued on page 96)*

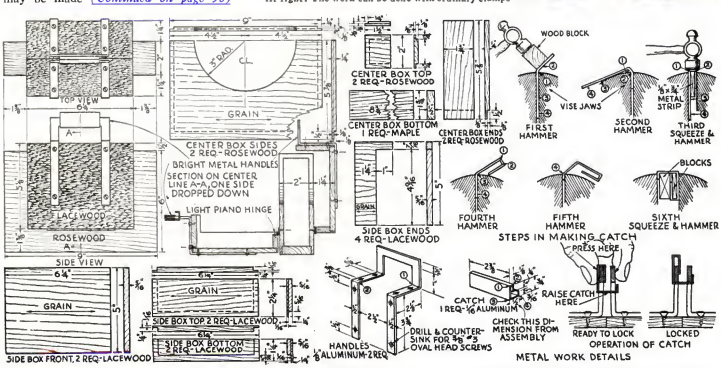
The piece with both side boxes open. It holds supplies for four card tables

At right: Using a simply made clamping jig for the first operation in gluing up the center-box parts



Applying pressure to the top and bottom pieces of a side box after the horizontal screws have been partly tightened. Later all screws are tightened. *At right:* The work can be done with ordinary clamps





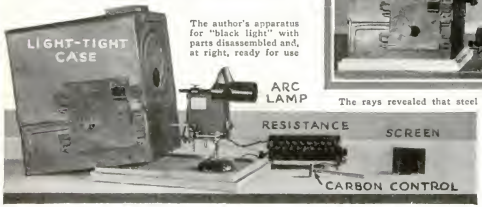
Top, side, and sectional views of the assembled case, details of all parts, and sketches showing steps in bending and operating the catch

Homemade *Ultra-Violet* Lamp

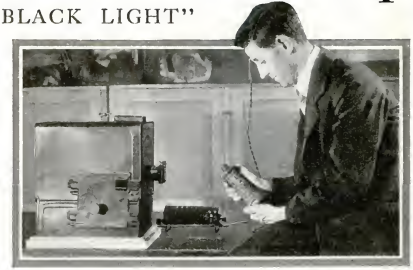
PRODUCES MAGIC "BLACK LIGHT"

With it you can perform unusual tests, do scientific sleuthing, and detect invisible erasures, stains, and sometimes forgeries

By Douglas Leechman



The author's apparatus for "black light" with parts disassembled and, at right, ready for use



The rays revealed that steel tools had been used on this ancient specimen

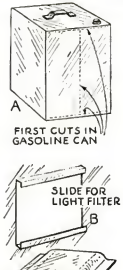
"BLACK light," most amazing of many recent additions to the equipment of the scientific detective, is easily produced in your own home with an expenditure of but little time and very few dollars.

These rays, the vibrations of which are shorter than are those of ordinary light, are called "black light" because they are quite invisible; but if an object is placed in their path, fluorescent light, similar to the light of luminous watch dials, is produced. Some materials glow with a dazzling blue, others a brilliant red or orange, and so on, almost every color being displayed by some chemical compound or other.

While the apparatus employed for producing these rays, as used in large technical laboratories, is complicated and expensive, an efficient ultra-violet lamp may be rigged up in an hour or less, once the necessary materials are secured. The essential equipment is: a carbon arc lamp in a light-tight box, a suitable resistance coil, and a glass screen that is opaque to visible light but transparent to the ultra-violet rays.

The carbon arc and its resistance coil can be taken from an old lantern-slide projector. Discarded models are often to be had from electrical shops. The type required is one that will run on 110 volts A. C., the ordinary house-lighting circuit.

In many cases projection arcs were made in light-tight cases, complete with a window for inspecting the arc and controls for the carbons. If you can get one of these, so much the better. If not, it will be necessary to build a box to house your arc. My own was made from a gasoline can measuring 10 by 10 by 14 in.



Make a cut right down the middle of one of the long sides of the can and again at right angles to the first cut at the top and bottom, as shown in the drawings at *A*. Bend out the two flaps thus formed till they are in the same plane as their neighboring sides. When in use, this open side forms the bottom of the box, but it obviously will not be light-tight until the space at each end is filled. To do this, cut two sheets of tin about 11 by 5½ in. and solder them into place, one at each end. Trim any rough edges with snips.

Make a baseboard about 12 by 16 in., center the box on the board, and tack strips of quarter-round molding on all four sides, but do not fasten the box (or can) to the baseboard as it must be taken off occasionally to get at the arc. The edges should be light-tight all round.

Now for the various openings necessary. The most important is that through which the ultra-violet rays are allowed to escape. To cut this, first place the arc in position on the baseboard and measure the vertical distance from the board to the point where the carbons meet. Then, at the front of the box—originally the bottom of the can—mark a point at the same height and equidistant from the two sides. This will be the center point of your opening, which should be cut to fit your screen or filter.

My screen is 2 in. square, but it happens that my arc lamp has a circular hood projecting from the front of it, so I cut a round hole to fit this and mounted my screen in front on a tube. If a square opening is used, part of the waste tin may be bent so as to form grooves for the screen to slide in as shown at *B*, or brackets may be soldered on to carry it.

A hole about ½ in. in diameter should be cut in the side of the box in such a position as to make inspection of the arc easy. A slip of colored glass—mine is green—should cover this hole, and it may be held in place with grooves like those holding the light filter.

Unless your arc has an automatic carbon feed, holes must be cut through which to pass the carbon controls. Their size and position depend entirely on the type of arc used. In my own case a single round hole was necessary.

There must be a ventilator in the top, as an arc light develops a good deal of heat. Cut two sheets of tin, one about 2 by 4 in. and the other 4 by 5 in., and bend them to the shape shown at *C*. Solder these over an opening cut above the arc, fitting them snugly enough to be light-tight. Give the whole box a coat of dull black, inside and out.

The arc lamp may be connected with the house circuit by an extension cord and plug after cutting in the resistance coil. It doesn't matter on which side of the circuit the coil goes, but it must be of the right capacity for the arc you are using. A switch somewhere near the baseboard is a convenience. Holes should be drilled through the baseboard for the wiring.

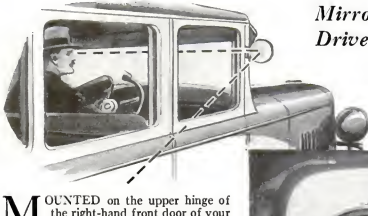
The glass screen may be obtained from several companies that make technical glassware and light filters. The screen I am using is double, that is, one in front of another, a total thickness of about 8 millimeters, and cost me two dollars. It is a very dark purple in color and quite black unless held up to a strong light.

Ordinary carbons may be used in the arc lamp, but the cored carbons specially made for the ultra-violet "health lamps" are better as they produce more of the wanted rays.

With this equipment set up in a darkened room, the *(Continued on page 96)*

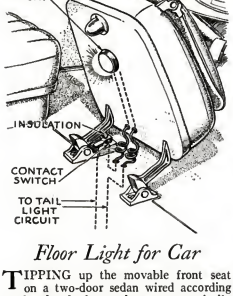
Hints Useful to Motorists

Mirror Mounted on Front Door Gives Driver Helpful Rear View in Parking



Drawing at left shows how mirror is mounted on front door hinge to show curb. Photo below gives view as seen from driver's seat

MOUNTED on the upper hinge of the right-hand front door of your car, a rear vision mirror can be so adjusted that it will show you the clearance between the running board and the curb when you are parking. Although an ordinary door-hinge mirror of the plate glass type is shown in the photograph at the right, a much wider view can be obtained if a curved, broad-vision mirror is used. A mirror adjusted this way will also aid the driver in traffic.

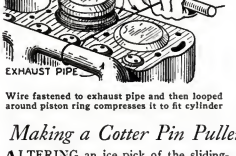


Floor Light for Car

TIPPING up the movable front seat on a two-door sedan wired according to the sketch shown above, automatically floods the floor and rear seat with light. The light, of the usual dome light type, is fitted into the underside of the seat and connected into the tail light circuit by means of two contacts, one on the seat and one on the floor. These are so arranged that they touch only when the seat is fully raised. Being connected into the lighting circuit, the device does not operate during the day when the other lights are not being used.

Fitting Piston Rings

AMATEUR mechanics, who have no special tools, can spring new piston rings into place by means of a loop of strong wire. The wire is anchored at one end to an exhaust pipe and then looped around the ring to be compressed. A suitable wooden handle, fastened to the other end of the wire, provides a convenient grip for pulling the wire. The tightened loop compresses the ring so it will slide easily into the cylinder. By pushing the piston down, the loop can be placed over the next ring and the process repeated.



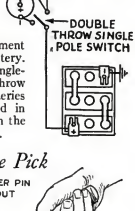
Wire fastened to exhaust pipe and then looped around piston ring compresses it to fit cylinder

Filing Your Brakes

EXTERNAL brakes that have become scored and grooved through long use often can be put back into first class shape with a coarse file. Jack up one wheel and remove the brake bands. Then, with the gear shift lever in high and the motor running a trifle faster than ordinary idling speed, apply the file (a twelve-inch fender file preferred) to the spinning drum in the manner shown in picture above. Sandpaper and steel wool can be used for the finishing touches.

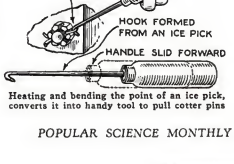
For Quick Starting

QUICKER starting in cold weather can be obtained if two dry batteries connected in series are used to supplement the storage battery. By means of a single-pole, double-throw switch the batteries can be connected in and cut out when the motor turns over.



Making a Cotter Pin Puller from an Ice Pick

ALTERING an ice pick of the sliding-handle variety, converts it into an efficient cotter pin puller. First, cut off about one inch of the pick and grind it to a blunt point. Then anneal the tip by heating it to a cherry red, bend the hook, and harden it by reheating and dipping it in water. In use, the hook is placed in the eye of the cotter pin, the handle slid forward and then jerked back. When removing heavy cotter pins it may be necessary slightly to open the split ends so that they can be pulled out.



Heating and bending the point of an ice pick, converts it into handy tool to pull cotter pins

NEW ANTI-FREEZE GIVES 4-WAY PROTECTION

1 Won't evaporate . . . fill now for the winter

2 Leaks less than water

3 Stops rusting and corrosion

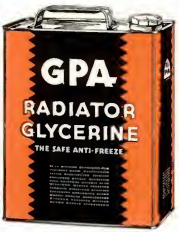
4 Positively will not clog or gum

PLUS **lower price . . . more economical than ever**

14 ADVANTAGES OF G. P. A.

1. Gives complete protection against freeze-ups to 30° below zero.
2. Will not evaporate — not even on the warmest days. One filling lasts all winter.
3. Leaks less than water.
4. Protects all metals of the cooling system against corrosion and the rust caused by tap water. This protection continues after G. P. A. is drained out.
5. Retards disintegration of rubber hose.
6. Positively will not clog or gum radiator.
7. Mixes quickly and permanently with water.
8. Never overheats motor.
9. Does not injure Duco or other finishes.
10. No unpleasant or dangerous fumes.
11. Safe — non-poisonous, non-inflammable.
12. Permits better operating temperatures.
13. Uniform in quality. Made to G. P. A. standards.
14. Lower in price. More economical than ever.

● *Why you can and should put G. P. A. in EARLY:* Since G.P.A. will not evaporate you can safely put it in early. Thus you avoid the last minute rush and all danger of early-season freeze-ups.



THE *New* G.P.A.
RADIATOR GLYCERINE

GLYCERINE PRODUCERS' ASSOCIATION, 45 EAST 17th STREET, NEW YORK, N. Y.

Send your personal greetings this year with

CAMERA-MADE Christmas Cards

Frederick D. Ryder, Jr., tells how to do it and gives hints on photographing children

"JOHN! You haven't done a thing about ordering those Christmas cards!"

My neighbor glanced sheepishly at me, and then at his wife, who was busy with her Christmas list at the desk in the corner.

"You would bring that up," he grumbled. "Oh, well, let's just write our names on ordinary stock cards as usual."

"Why don't you make your own Christmas cards?" I ventured to suggest.

"How, for instance?" he scoffed. "I'm no artist. Do you expect me to pull them out of my hat like a magician?"

"You could do it with your camera," I explained. "It's a cinch to make cards that way and you get something really distinctive and personal—something your friends will appreciate a lot more than a high-priced engraved job."

"You mean to print a picture on part of the card and letter in the greetings?" John questioned. "If that's it, nothing doing—takes too much time."

As I pointed out to John, it is perfectly practical, with the aid of your camera and flashlight, to duplicate the lettering photographically. An ordinary roll-film camera and a photoflash bulb will do the trick. No special equipment is required.

Whether you do the lettering by hand or not, the first problem is to take the photograph that is to go on the card. Don't use one of last summer's snapshots or any other old picture your friends have already seen. A brand-new picture will double the interest in your greeting. Perhaps the best bet is a good picture of a baby or of a group of young children. The face of a smiling child will add a cheerful note to the most formally phrased greeting card. Of course, in some cases a picture of a grown-up or even an interior "shot" of your living room may be more appropriate.

There are any number of ways to pose children. One that fits in with the Christmas idea, for example, is to have the child hanging a stocking to the mantel over the fireplace.

You can't make babies pose. You must watch your chance to get the kind of picture you want. In any case, all indoor pictures of children can best be taken by flashlight. And that goes double strength for babies! It takes fast work even to keep an active and playful baby in front of the camera, so what chance have you to dictate the position of its arms or legs, or choose the facial expression it is desired to assume?

The photoflash bulb is especially valuable for taking pictures of babies because the quick, silent flash of light does not seem to disturb them at all. I took four

The type of card you can turn out easily with your camera. The baby's picture is pasted in a space left on each card as shown at left

$100 in Cash for PHOTOGRAPHS of Children

SIX cash awards amounting to $100 are offered by POPULAR SCIENCE MONTHLY for the best pictures of a child or a group of children taken indoors—pictures of a type suitable for making Christmas cards as suggested by Mr. Ryder in the accompanying article.

It is not necessary to submit a complete Christmas card; all that is required is an unmounted print and the negative from which it was made, as the contest will be judged on the photographic quality, the naturalness, and the human interest appeal of the picture.

All the old drawbacks of taking pictures of children in the house have been overcome by the introduction of photoflash bulbs, which make no noise, dust, or smoke and involve no fire risk.

FIRST AWARD	$50
SECOND AWARD	25
THIRD AWARD	10
FOURTH, FIFTH and SIXTH AWARDS, $5 each	15
TOTAL	$100

The contest is intended primarily to encourage you to learn to use this modern method of taking indoor photographs, but daylight or any kind of illumination or flashlight may be used. The developing and printing may be done by a professional, but the picture must be taken by an amateur during the months of November and December, 1932. Mail both print and negative to the Photographic Editor, POPULAR SCIENCE MONTHLY, 381 Fourth Avenue, New York, not later than January 1, 1933, and mark your entry "December Photo Contest." Also write on the back of the print whether daylight or artificial light was used, and if flashlight, which type. You may enter several photos, but none will be returned. This contest is open to all except employees of POPULAR SCIENCE MONTHLY and their families. In case of ties, each tying contestant will be awarded the prize tied for.

How a letter brought
NEW MAGIC TO JIM'S CAMERA

● *All of these illustrations as well as this indoor snapshot of Jim's were taken with G. E. MAZDA Photoflash lamps.*

Take prize
INDOOR pictures this easy way

TO SNAP *Action* scenes in the house, use G. E. MAZDA *Photoflash* lamps. These magic lamps enable ordinary box and folding type cameras to get pictures of children, parties and pets, indoors . . . or of scenes outdoors at night . . . as easily as in sunlight.

For time exposures . . . portraits . . . interiors . . . and posed groups, use G. E. MAZDA *Photoflood* lamps. They enable you to secure beautiful, clean-cut pictures with time exposures of 1 to 5 seconds. *These new G. E. MAZDA Photoflood lamps are also the best lamps ever developed for home movie-making.*

Ask your photo-supply dealer or druggist about these two picture-taking lamps. Better still, get some lamps and try a few indoor pictures. That will convince you. General Electric Company, Nela Park, Cleveland, Ohio.

GENERAL ELECTRIC CO., *Nela Park, Cleveland, O.*

FREE: Please send me, free, a copy of "How to make GOOD pictures INDOORS" F. S.M. 12-1932

Name _____

Address _____

City _____ *State* _____

G. E. MAZDA Photoflash lamp

G. E. MAZDA Photoflood lamp

GENERAL ELECTRIC

MAZDA PHOTOFLOOD and PHOTOFLASH LAMPS

photoflash pictures of a year-old baby, one of which appears in the sample Christmas card, and the little fellow didn't seem to notice them at all, although the four of them were touched off within a few feet of his nose.

One of the biggest difficulties in taking pictures of very young babies is in placing them where the camera can get them without encumbrances such as the fond parents' hands or arms. Another is in keeping the baby in the spot where it is in focus. Here's a tip that will help:

Place the infant in a large padded library chair. Focus with the baby held against the back of the chair. Then the mother can let go and get her arms out of the picture. At that instant ring a small bell or introduce some other similar diversion. If you are lucky, the baby will assume just the expression you want before it starts to roll around or climb forward in the chair. If the bell doesn't attract its attention the first time you try it, the mother can push the infant back to position again for another attempt.

Of course the camera should be firmly supported in position with a tripod, and the room should be brightly lighted to minimize the effect of the flash.

Remember that the secret of success in taking baby pictures is almost unlimited patience. Don't press the button on the photoflash lamp till you get just the expression you want. If you shoot at the first half-way-right smirk the baby assumes, ten to one he'll hand you a beautiful smile just after the shutter closes.

After you have taken a suitable picture, the next job is to design an appropriate card. Do this roughly in pencil at first, keeping in mind the film size of your camera and the dimensions of the child's picture trimmed to the size you wish to use.

The lettering and ornamentation are drawn on a large sheet, and space is left for the baby's picture. Then a photograph is made by using a portrait attachment and illuminating the card with a photoflash lamp

Assuming that you have an ordinary roll-film camera, you cannot get close enough to a small lettered card to copy it photographically. The solution is to letter a much larger card and then photograph it down to the dimensions of your film with the aid of a portrait attachment.

Incidentally, the execution of the lettering and decorations on the large card can be relatively crude.

First set up the camera exactly 3 ft. from any convenient vertical flat surface and mark off on the surface the corner limits visible in the finder. Cut a large sheet of plain white paper or white cardboard to this size.

Consider this sheet as an enlarged Christmas card and figure out just where the picture is to appear and where you want the lettering. Do the lettering with black drawing ink, making the letters proportionately large and with coarse lines.

Photographing the enlarged card is simple. Place it on the marked place on the wall, see that the portrait attachment is in place on the lens and that the distance from lens to paper is exactly 3 ft. Make sure that the camera is in line with the center of the card and that the finder takes in all the corners. Then set the lens at stop 16, open the shutter, and touch off a photoflash lamp held about 2 ft. above the camera as shown above.

Double-coated film, such as verichrome, is best for this work. If you develop the film yourself, increase the time of development about fifty percent.

The finished film should show almost clear lettering against a nearly black field. This film should be printed on the hardest or most contrasty grade of paper so as to have the lettering black and the rest of the paper white.

This gives you jet black lettering against a clear white background, but that is by no means the only possible combination. Numerous toning solutions suitable for amateur use can be obtained at any photo supply store. For example, you could redevelop to sepia, which would give you rich brown lettering against a white background. The lettering could be made other colors against white, or you could tone the background pink or some other shade, leaving the lettering black. Elaborate combinations, with the lettering toned to one color and the background dyed to a different contrasting or harmonious shade, are possible if you wish to go to the extra trouble involved.

If you have figured out your design correctly, there will be a blank space on the print in which you can paste the small picture of the child, after you have trimmed the latter to the desired size. The result is a finished Christmas card such as is shown on page 78.

If you have a small camera, so small that the picture size is not big enough for a Christmas card, you can arrange a card that has all the lettering bunched together on one small area. Then you can print, or have your photofinisher print, your small negative of the lettering through an opening in a mask of black paper large enough to cover the whole of the card size you want.

It also is possible to combine the negative of the baby with the one containing the lettering and decorations by cementing them to proper sized openings in a black paper mask. This, of course, eliminates pasting the small print on the large one for each finished Christmas card. The combination negative does not, however, give such artistic results because the lettering portion will appear gray.

Photo Contest AWARDS

FOR the best photograph submitted in our August Photo Contest (P. S. M., Aug. '32, p. 92), Wilton Fisher, Tulsa, Okla., has been awarded a prize of $10. The following won honorable mention in the same contest: Harry A. Arnold, Jr., Miles City, Mont.; James Clarke, Honolulu, Hawaii; Frederick Gerding, Schenectady, N. Y.; John R. Kennedy, Toronto, Canada; William Noertenhaeuser, Barnum, Wis.; Mrs. H. M. Pridham, Daytonia Beach, Fla.; Fred W. Ruttger, Jamaica, N. Y.; Joseph Schwarz, New York City; J. M. Stofan, Garfield, N. J.; Charles C. Tomney, New Brunswick, N. J.; Jack Warner, Beverly Hills, Calif., and Ruskin B. Warren, Bel Air, Md.

Eastman announces a New *Ciné-Kodak*.. $29.50

CINÉ-KODAK EIGHT *is small, simple. A real full-fledged movie camera. Price only $29.50.*

using a NEW FILM that cuts movie costs *nearly* 2/3

AN entirely new-principle home movie camera. An entirely new low-cost film. Giving home movies millions can afford.

Ciné-Kodak EIGHT — a real, full-fledged movie camera, Eastman-made. Takes beautiful, clear, sharp movies. Only $29.50 (you pay no federal tax; Eastman pays it).

The new film does four times the work. A 25-foot roll at $2.25 runs as long on the screen as the usual hundred-foot roll at $6. You save 62½%. No extra cost for finishing.

Then, you show your films in Kodascope EIGHT... throws strong, steady, flickerless movies . . . only $22.50.

Don't fail to visit your Ciné-Kodak dealer. See this remarkable, completely new-idea movie camera . . . and the new Kodascope. See the actual movies on the screen. Eastman Kodak Company, Rochester, N. Y.

• THE NEW PRINCIPLE

Ciné-Kodak Eight makes a special 25-foot film, 16 mm. wide, do the work of 100 feet. It runs the film past the lens twice, leaving two separate rows of images along its full length. Eastman finishes this 25-foot 16 mm. film, slits it, splices it, and returns it to you as a single 50-foot 8 mm. film, ready to project in Kodascope Eight. Cost of finishing is included in the price of the film.

It is this Eastman invention that brings you home movies at 62½% saving.

Ciné-Kodak EIGHT

Eastman's NEW-PRINCIPLE *Movie Camera*

New "Delta" Circular Saw Revolutionary *in* Design!

The last word in circular saws! Designed completely new from the ground up. Incorporates every feature that woodworkers have wanted for years—yet is so moderately priced as to be within the reach of all.

Delta engineers, after painstaking tests on all types of work, have made this a TILTING TABLE design (no tilting arbor)!

NEW IDEA Gives 4-Foot Table Capacity at Extremely Low Cost!

A Complete Line of Motor-Driven Tools for Home Shops and Factories

"Delta" Woodworking Units are convenient, portable and compact. All are available in a large variety of combinations and at prices to fit all needs. The "Delta" line includes Jointers, Circular Saws, Band Saws, Woodturning Lathes, Drill Presses, Scroll Saws, Boring, Routing, Sanding and Mortising Attachments, and a complete line of accessories.

New "Delta" DRILL PRESS

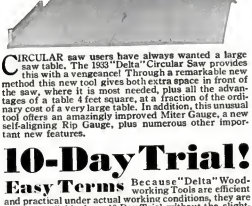
The new "Delta" Drill Press, measuring 66 inches high and provided with heavy floor base, is a precision tool—built to meet the most exacting demands of production work, and yet priced unbelievably low. It incorporates numerous new features. Is really two machines in one—as the head can be reversed and used efficiently as a Shaper, Hollow Chisel Mortising Attachments available.

New "Delta" SCROLL SAW

Runs at full motor speed—1800 strokes per minute—all springing and twisting eliminated, with perfect balance and absence of vibration. Produces fine, smooth and accurate work. **Has 24 inch throat capacity and will saw wood 2 inches thick!** Works on metal and fibre as well as wood. It can be used for filing, sanding, and boring.

New Woodturning Lathe

This unusual machine incorporates numerous new ideas in construction and design that give it extraordinary strength and rigidity, plus the accuracy and convenience ordinarily found only in lathes selling for many times its price.



CIRCULAR saw users have always wanted a large saw table. The 1933 "Delta" Circular Saw provides this with a vengeance! Through a remarkable new method this new tool gives both extra space in front of the saw, where it is most needed, plus all the advantages of a table 4 feet square, at a fraction of the ordinary cost of a very large table. In addition, this unusual tool offers an amazingly improved Miter Gauge, a new self-aligning Rip Gauge, plus numerous other important new features.

10-Day Trial!

Easy Terms Because "Delta" Woodworking Tools are efficient and practical under actual working conditions, they are always available for a 10-Day Trial without the slightest risk. Satisfaction is guaranteed. For full details of this liberal offer and also of "Delta" Easy Payment Plans, fill in and mail the convenient coupon which appears below—TODAY!

Catalog Free

Every man who works with wood—in factory or home workshop—will want to see this FREE 1933 "Delta" Catalog of Quality Woodworking Tools. It shows the complete line of latest "Delta" Tools. It is packed full of interesting illustrations and descriptions. It describes the latest developments in motor-driven equipment at the astonishingly low 1933 price levels. Fill out the coupon below and mail it TODAY!

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Please place me, without obligation, on mailing list to receive the FREE 1933 "Delta" Catalog of Quality Woodworking Tools. Also send full details of your 10-Day Trial Offer and Easy Payment Plans.

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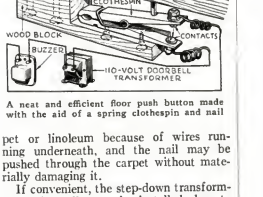
Address .....

City ..... State .....

EASY WAY TO INSTALL FLOOR PUSH BUTTON

A SERVICEABLE floor push button for an electric bell or buzzer may be made from an ordinary spring clothespin, a block of wood, a nail, a washer, and a few wood and machine screws. The accompanying sketch is self-explanatory.

This style of switch has the advantage that no worn spots will appear on the car-

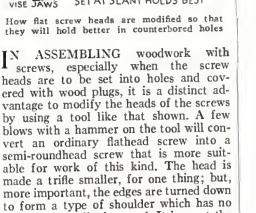


A neat and efficient floor push button made with the aid of a spring clothespin and nail

pet or linoleum because of wires running underneath, and the nail may be pushed through the carpet without materially damaging it.

If convenient, the step-down transformer or dry cells may be installed close to the switch, thus keeping them out of sight and saving the cost of running extra wires.—F. W. HUTCHINSON.

MODIFIED SCREW HEADS FOR SPECIAL JOINTS



How flat screw heads are modified so that they will hold better in counterbored holes

IN ASSEMBLING woodwork with screws, especially when the screw heads are to be set into holes and covered with wood plugs, it is a distinct advantage to modify the heads of the screws by using a tool like that shown. A few blows with a hammer on the tool will convert an ordinary flathead screw into a semi-roundhead screw that is more suitable for work of this kind. The head is made a trifle smaller, for one thing; but, more important, the edges are turned down to form a type of shoulder which has no tendency to split the wood. It has not the wedging action of an ordinary screw head and seats itself more securely.

A few screws treated in this way, if properly placed in a door that has pulled apart at the joints, will effect a permanent repair. When the screws pass into end grain wood, as in this case, it is desirable to drive them at a slight angle rather than straight.—MAX CHARLES PRICE.

BENT TACKS GIVE WOOD SCREWS BETTER GRIP

IT IS often difficult to make a wood screw stay permanently in place once the hole has become enlarged. A good way to do it, however, is to take three or more small tacks, bend them as shown above, and place them head down in the hole before replacing the screw. If the hole has become much too large, place tacks in it as before, then drive in a plug of wood and insert the screw. This method works well on loose door hinges and in repairing the bodies of trucks and other vehicles. Recently I used it to repair an electric iron handle.—J. F. GOODMAN.

1932 Home Workshop INDEX NOW READY

IF YOU have kept all the 1932 issues of POPULAR SCIENCE MONTHLY as so many readers make a practice of doing, you own a gold mine of up-to-date home workshop reference material—almost 400 pages relating to the shop and to craft work in all its phases, including practical suggestions in regard to automobiles, and up-to-the-minute radio information. All you now need to make this great mass of valuable information immediately useful is a complete alphabetical index, so that you can find anything you want in an instant. An index for the twelve issues of 1932 has been prepared and will be sent to any reader for ten cents to cover the cost of printing and mailing.

The demand for the 1931 and 1930 indexes was so great that they had to be reprinted, and a few copies are still available at ten cents each. If you wish one or all of these indexes, fill out the coupon below and mail it without delay.

Popular Science Monthly
381 Fourth Avenue, New York, N. Y.

Please send me the Home Workshop Index or Indexes checked below, for which I inclose ten cents each.

☐ 1932 ☐ 1931 ☐ 1930

Name.....

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City.....State.....

Note: Please print name and address very clearly.

JACK HAZZARD *tells how to make*

Cruising Equipment *for a* Canoe

Paddle, leeboard, mast and spars, sail, tent, and cover

Spokeshaving a paddle blade. The handle is left square until the blades are finished

IN THE long winter evenings ahead, the enthusiastic canoeist who aspires to make as much as possible of his own equipment, can spend many happy hours on the special equipment and accessories for the POPULAR SCIENCE MONTHLY 16-ft. canvas covered kayak described in three previous articles (P.S. M., Sept. '32, p. 57, Oct., p. 70, and Nov., p. 86).

The balanced lug sail is well adapted to this canoe. It combines maximum sail area with short, light spars which can be conveniently stowed below deck.

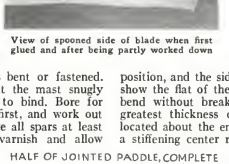
The spars are made of straight grain spruce. A ferrule of brass is fitted to the foot of the mast and filed to slip into its tube smoothly. Just at the top of the mast tube, a piece of rawhide or heavy leather is shrunk and glued to the mast to take the wear of the jaw and to keep the mast from forcing down against the keel. At the head the mast is bored in a fore-and-aft direction with a hole large enough to take the ¼-in. braided halyard. Round away the lower edges of this hole, and serve the head of the mast to prevent splitting above and below the hole. The edge of the grain in the mast should lie athwartship.

Bore small holes 1 in. from the end of each spar to take the chalk line with which the sail is bent or fastened.

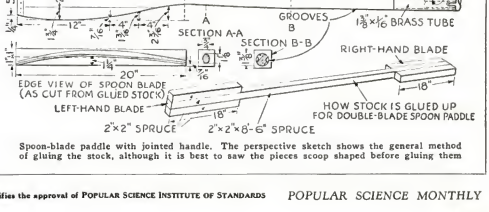
Shape the jaw to fit the mast snugly but not tight enough to bind. Bore for the end of the boom first, and work out the jaw afterward. Give all spars at least three coats of spar varnish and allow ample time for them to dry before use.

A good grade of airplane cloth makes a fine sail, but there must be at least three thicknesses wherever grommets are to pierce the sail, at head and foot, and along the lines for reef points. These points should also be double-stitched.

The leeboard—one is sufficient—can be made of cedar or mahogany, but spruce is probably the best material because of its stiffness. It makes no difference on which side the board is carried, but usually it is to starboard. The edge grain of the board should point toward the bow of the canoe when the board is in position, and the side of the board should show the flat of the grain, so that it will bend without breaking like a bow. The greatest thickness of the board will be located about the end of the thwart, with a stiffening center running down through



View of spooned side of blade when first glued and after being partly worked down



Spoon-blade paddle with jointed handle. The perspective sketch shows the general method of gluing the stock, although it is best to saw the pieces scoop shaped before gluing them

Dec 1932

the length of the board directly below the hole for the pin which holds the board to the thwart. The lower and after edges of the board are planed thin (⅛ in.), while the leading edge is tapered gently to ¼ in. at the water line and rounded.

Maple, ash, or spruce are suitable for the leeboard thwart. It is important that the joints be tightly fitted, well glued, and carefully fastened with screws.

THE movable thwart should be of maple. It is fastened between the frames at any desired point in the cockpit by the use of small C-clamps. The back rest has two strips of maple nailed across the back at the right height to engage the edge of the thwart.

The cockpit tent, large enough for one canoeist to sleep in it comfortably, requires 8 yd. of 8-oz. canvas. An army mosquito bar is easily adapted for hanging inside to make the tent insectproof. A chalk line runs through the paired grommets in the lower edges and is looped around screws beneath the outwale and drawn taut, holding the tent in place. Sleeping in the canoe ashore will not damage the bottom if arrangements are made to prevent rolling and to assure a bearing the full length of the keel.

A double-blade paddle is needed to complete the outfit. The ideal type is 8 ft. 6 in. long and has feathering, spoon-shaped blades. A piece of spruce 2 by 2 in. by 14 ft. 6 in. will be necessary. Plane the material square and mark the center line on all four sides. Cut a 3-ft. section from each end from which to saw the two side-pieces for each blade. Lay the edge pattern of the blade on one end of the long piece, adjusting carefully with reference to the center line. Mark and saw out. Using the edge pattern again, mark the 3-ft. pieces. Saw the two pieces out and glue to the end of the long piece just cut, clamping firmly. Treat the other end of the blade similarly, arranging the side-pieces to give 90-deg. between blades.

WHEN the glue is thoroughly dry, work the blades to the desired thinness and crown, which runs down the center back. Work down the handle, noting that it is not round where it tapers into the blades, but oval, with the greatest dimension in line with the thrust. If the blades are jointed, the ferrule will work loose after a time unless extreme care is exercised in fitting.

To lighten the handle, cut a rounded groove on each side of each half of the handle in a plane with the edges of the blades. Make the groove ½ in. wide at the center, 7/16 in. deep, and tapering out to nothing 7½ in. from the throat of the blades. Handgrips are left 6 in. each side of the center, and the grooves between the grips are only ½ in. wide and ¼ in. deep as there are four of them.

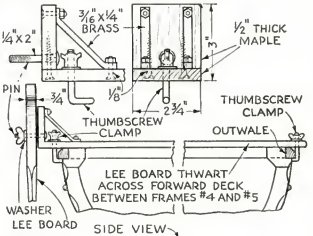
For cruising in stormy weather, a cockpit cover is a comfort. It is fastened to the same screws which hold the tent and in the same manner. A small triangular piece of brass fitting over the apex of the coaming holds in place the forward end of the cover and takes the wear off the material, as it is sewn under the cloth.

The collar of canvas surrounding the opening in which the paddler sits should

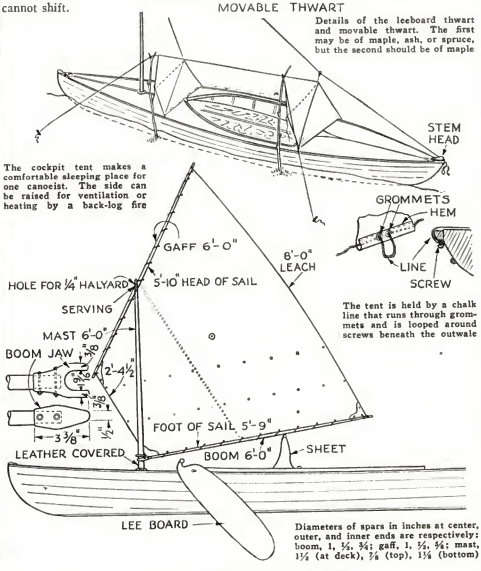
be at least 6 in. in height and provided with a loose running draw string, which is drawn up but never tied. A very roomy, loose fitting, pull-over jacket of material similar to the cover is slipped on and the skirts of the jacket are dropped outside the collar. A string in the waist of the jacket is drawn snug, and the paddler is ready for wet weather. Six-ounce duck is suitable for cover and jacket when thoroughly waterproofed.

One objection to the canvas covered canoe is that it lacks flotation in case of an upset. In this canoe, however, the cloth is so thoroughly impregnated with dope that it cannot absorb much water. An additional safeguard is to shove a pair of small inner tubes into the ends on top of whatever duffle has been stowed there. When pumped up, the tubes furnish extra flotation in case of upset and also wedge the duffle so that it cannot shift.

Here is a canoe and outfit in which a competent canoeist can go almost anywhere there is enough water, barring rapids, for which this canoe is too sharp ended. He will travel fast without undue expenditure of power, and a rainy day will not keep him ashore.



Details of the leeboard thwart and movable thwart. The first may be of maple, ash, or spruce, but the second should be of maple



The cockpit tent makes a comfortable sleeping place for one canoeist. The side can be raised for ventilation or heating by a back-log fire

The tent is held by a chalk line that runs through grommets and is looped around screws beneath the outwale

Diameters of spars in inches at center, outer, and inner ends are respectively: boom, 1, 1/2, 3/4; gaff, 1, 1/2, 3/4; mast, 1 1/4 (at deck), 3/4 (top), 1 1/4 (bottom)

HOME EXPERIMENTS IN ELECTROCHEMISTRY

(Continued from page 50)

become a conductor of electricity and is said to be *ionized*. The resulting solution is called an electrolyte and by means of a simple arrangement of apparatus we learned how to distinguish an electrolyte from a non-electrolyte.

In our last experiment with the salt solution we have made use of the process of ionization. Dissolving the salt in water causes the sodium chloride to split up into minute electrically-charged particles or ions. The sodium particles carry a positive charge of electricity and the chlorine a negative charge. These particles or ions are so small that they cannot be seen even by a powerful microscope but they exist and play an important part in the process of electrolysis.

By connecting the carbon rod to the positive terminal of the batteries, we give it a positive charge of electricity. Experiments with magnets have shown us that like poles or charges repel and unlike attract. Similarly, since the carbon is positive, it attracts the negative chlorine particles or ions and repels the positive particles of sodium. In a like manner, the negative copper strip attracts the positive particles of sodium and repels the negative chlorine ions.

BEING attracted to electrodes carrying a charge opposite to their own, the chlorine and sodium particles or ions lose their charge and become sodium and chlorine. When each chlorine particle loses its charge, it becomes chlorine gas and appears on the surface of the carbon rod in the form of bubbles. Sodium, however, is very active when brought in contact with water so that, as the sodium particle loses its charge by coming in contact with the copper strip, it reacts with the water to form hydrogen gas which is given off in bubbles on the surface of the copper.

Rivaling the tree of lead experiment described in a recent issue (P.S.M., July '32, p. 61) is the tin tree which can be grown in less than a minute by the action of electricity on a tin solution. Dissolve about a teaspoon of tin chloride (stannous chloride) in a half glass of water and add several drops of hydrochloric acid. Sufficient acid should be added to make the solution quite clear.

Pour the solution into a U-shaped glass tube mounted in the manner illustrated in the circle on page 61 and place a copper wire in one end of the tube and a carbon rod in the other. These electrodes are then connected to a set of two or three dry batteries connected in series—the carbon being connected to the positive terminal and the copper to the negative.

IMMEDIATELY, beautiful crystals of tin will form on the surface of the copper wire. If the action is continued, a growth of two inches will be formed in about one minute.

The amateur who has no U-tube suitable for his electrolysis experiments can make a suitable arrangement from two olive bottles as shown in Fig. 4. Remove the bottoms of the bottles and smooth any rough edges that may be formed. Fit a stopper into the mouth of each bottle and pass a short glass tube through a center hole in each stopper. A short length of tubing forms the U-shaped bend.

The solution to be used for the electrolysis is poured into the bottles and the rubber tubing is squeezed to remove any air bubbles. The electrodes are then placed in the solution through the open tops of each bottle.

In electrochemistry, dry batteries, a storage battery, a battery charger, or any other source of direct current can be used. Because it flows in two directions, however, alternating current cannot be used where a definite reaction in one direction is desired.

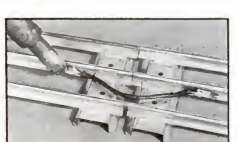
MAINTAINING Model Railway Motors

IN GOOD CONDITION . . . AND OTHER HINTS

Block for Gaging and Straightening Track

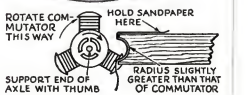
NO MATTER how careful you are, occasionally a section of track gets stepped on. If the rails are badly bent, it will be simpler to substitute a new section, but when the damage is not serious it is easy to make repairs with a gage and straightener such as shown above. It consists of a 1 in. thick board, preferably hardwood, into which have been cut three grooves about ¼ in. deep and corresponding in width and spacing to the three rails of the track.

If the rails are only slightly bent, you can start them into the grooves at one end and force them through. The better method is to use the board solely as a gage to guide in straightening the kinks.



Bonding Third Rails

THIRD-RAIL connecting pins are supposed to fit tightly so as to give a good electrical contact. Occasionally they do not, and the resulting poor contact causes the train to go slow at some point in the track circuit. Furthermore, these bad contacts may be found where they are inconvenient to fix, for example, in the middle of a long straight stretch that is already screwed to the floor. The cure is a soldered bond as shown above.



Truing Commutators with Sandpaper

A WEAK spot in all model railway motors is the commutator. When a train stalls or a locomotive loses its pep, chances are about ten to one that the commutator or the brushes are to blame.

In theory the graphite brush is supposed to supply just the right amount of lubricant to keep the rolled copper gauze brush from cutting the commutator surface. In practice, however, dust and lubricating oil from the bearings form a gummy black deposit on the commutator surface, and the current no longer flows freely. Sparking increases, and the edges of the commutator segments start to burn away.

Frequent cleaning with gasoline keeps the trouble at a minimum, but eventually the commutator becomes so roughened that the brushes will not function as they should. When similar trouble occurs on a large motor, the practice is to place the whole armature in a lathe and turn a new surface on the commutator, but on a model railway motor the work can be done without a lathe. Cut a semicircular notch in the end of a small, flat piece of wood by drilling a hole and then sawing away the end. The hole should be slightly larger in diameter than the commutator, as indicated in the diagram above. Hold the commutator against a piece of No. 00 or finer sandpaper in the notch, with the thumb on the end of the axle, while you rotate it with the other hand. Never use emery paper.

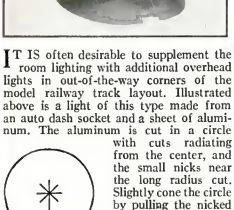
Using Rheostats in Multiple

ON ELABORATE model railway layouts, planned for the running of several locomotives at the same time, trouble is usually encountered with the rheostat control. The cure for this is to assemble a multiple rheostat such as that illustrated, and divide your layout into sections, each section being controlled by a separate one of the grouped rheostats.

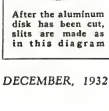
The heavy-duty 2-ohm rheostats sold for radio laboratory work are suitable. One of them will handle a standard gage double-motor locomotive without overheating. To remove the individual shafts and substitute a long shaft is easy; and a heavy aluminum or brass strip will "gang" one row of connections.

Diagram showing way to connect the multiple rheostat to the various third-rail sections

Small Reflector Made Without Soldering



IT IS often desirable to supplement the room lighting with additional overhead lights in out-of-the-way corners of the model railway track layout. Illustrated above is a light of this type made from an auto dash socket and a sheet of aluminum. The aluminum is cut in a circle with cuts radiating from the center, and the small nicks near the long radius cut. Slightly cone the circle by pulling the nicked edges till the nicks overlap. Bend the tabs thus formed in alternate directions. Now push the socket through the points.



After the aluminum disk has been cut, slits are made as in this diagram

HOME WORKSHOP BLUEPRINTS

New projects are marked with an asterisk (*)

TO ASSIST you in your home workshop, POPULAR SCIENCE MONTHLY offers large blueprints containing working drawings of a number of well-tested projects. The blueprints are 15 by 22 in. and are sold for 25 cents a single sheet (except in a few special cases). Order by number. The numbers are given in italic type and follow the titles. When two or more numbers follow one title, it means that there are two or more blueprints in the complete set. If the letter "R" follows a number, it indicates that the blueprint or set of blueprints is accompanied by a special reprint of the instructions originally published in the magazine. If you do not wish this reprint, omit the letter "R" from your order and deduct 25 cents from the price given. Reprints alone are sold for 25 cents each.

Flying Airplane Models

Bremen (Junkers, 3-ft. Flying), *89-90*.....$ .50
Lindbergh's Monoplane (3-ft. Flying), *69*..... .25
Nieuport XVII (29-in. flying), *160-161*..... .50
Rise-off-Ground Tractor, 3-ft., *50*..... .25
Seaplane, Tractor, 30-in., *87*..... .25
Seaplane, Morris (Record 12½ min.), *102*..... .25
S. E. 5a World War Plane (30-in.), *168-169* .50
Single Stick, Tractor, 30-in., *82*..... .25
Tractor (Record Flight 6,024 Ft.), *104*..... .25
Twin Pusher, Racing, 35-in., *86*..... .25
Winnie Mae (4-ft. flying), *141-142-143*..... .75

Boats

Canoe, Sailing Outfit, *25*..... .25
Canoe, 16-ft. Canvas Covered Kayak, with Sail, etc., *122-123-124*..... .75
With full size patterns..... 2.25
Duck Boat, Folding, *170-R*..... .50
With full size patterns..... 2.00
Outboard Racer, 11½-ft., *128-129*..... .50
With full size patterns..... 2.00
Sailboat-Motorboat, Knockabout (15 ft., cat rig), *131-132-133-R*..... 1.00
With full size patterns..... 2.50
Marconi Rig with Jib for Above, *123A*..... .25
13-ft. Rowboat-Motorboat, *147-R*..... .50
With full size patterns..... 2.00
14½-ft. Rowboat-Motorboat, *148-R*..... .50
With full size patterns..... 2.00
16-ft. Rowboat-Motorboat, *149-R*..... .50
With full size patterns..... 2.00
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(See page 104 for kit of materials)
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WHAT YOU CAN DO WITH A MICROSCOPE

(Continued from page 53)

mounted in handles. It will be found that old paint brush handles (for water colors) may be cut off and used. These, too, are split and the ends of the needles bound in place. A little shellac applied to the thread will make it wear better. One of the needles is bent and to do this it will be necessary to heat it in an alcohol flame until it is red. The needle will then bend easily. Afterward it should be re-heated and plunged into cold water to bring back its hardness. It will be found that these needles will have to be dressed up from time to time on a fine pocket stone. They should be wiped off with thin oil each time they are used to prevent them from rusting between excursions.

Now for the forceps. A cheap pair, the smaller the better, may be bought. It will be found that the cheap ones do not set perfectly and this makes a little job for us in stoning and tapering the ends down until they come together perfectly. A little patience will be needed until a nice fit is produced. It should be borne in mind that the things handled are tiny almost beyond words and they slip out of anything but the most confirmed grip. These forceps should be treated with oil each time they are used.

A MEDICINE dropper completes the outfit. If another with a curved spout can be obtained, so much the better. For the time being, this completes the "baggage." As time goes on, we shall have the fun of making more accessories but for the moment we must keep in mind the fact that we are rookies at the game and we cannot learn to do everything overnight.

Now let's say a word or two about the lenses. It should be borne in mind that the metal parts of our microscopes amount to so much junk if the optical side of the instrument is destroyed through improper care. The lenses must be kept clean and free from every trace of grease and lint. A piece of lint in our machine will look something like the skeleton of a twenty-five foot boa constrictor under the lens.

To keep the lenses clean, we must not wash them in the ordinary sense of the term. Indeed if we take proper care, we need only gently wipe them off with the soft toilet tissue that may be bought in any five and ten cent store. Ordinary tissue paper is far too coarse and will scratch the comparatively soft and beautifully ground glass. If some real dirt sticks to the lens, we may use a bit of grain alcohol and tissue to remove it. In short, we treat our lenses as though they were worth their weight in gold. They should NEVER be touched with the fingers. If you could see the ends of your fingers under a microscope you would need no other explanation as to why this is true.

NOW for a peek. But wait, for we must proceed with a professional air. Otherwise we shall be all fingers and thumbs and might possibly damage our equipment. First, we look about the house for subjects. We don't have to look far for our very person has plenty. We might pluck a hair out of our head, or take a tiny flake of skin that has dried. About the house we can find a bit of vinegar, salt crystals, or an old razor blade. However, as we shall discover later, things like old razor blades do not transmit light and consequently we could only hope to see the shadow outline of such an article with light coming up from below.

For convenience, let's choose the hair. If you have not seen a human hair under the microscope, you will be amazed. Contrary to what you might expect, we do not take the hair in our *(Continued on page 93)*

WHAT YOU CAN DO WITH A MICROSCOPE

(Continued from page 92)

fingers and stick it under the objective of the microscope and then adjust the instrument so that we can see it. As a matter of fact, this procedure would be quite impossible. First, we could not hold the bair still enough and secondly we should be faced witb the necessity of holding it within an area measuring only a few thousands of an inch in diameter. Quite a chore for untrained hanerd!

With every microscope there comes a few slip glasses. These are thin little strips of clear glass and it will be found that our microscope is provided with little flat springs arranged on the stage in such a manner that these little slips may be held by them. What we do then is to take two slip glasses and place the bair between them. The whole arrangement is then slipped in place on the stage. Take care NOT to finger the slip in the vicinity of the specimen for if we do we shall be surprised to find great smears of grease sweeping across our field of vision.

THE next step is most important because it marks the good microscopist and because if we do not follow directions we shall run the risk of ruining part of our instrument. After the specimen is in place, we take the coarse adjustment screw of the machine that controls the metal tube into which the objective and occular is placed and move it downward until the tip of the objective is about a quarter of an inch from the surface of the slide or slip glass. With higher powered machines, it is necessary to move the objective a little closer.

As we do this, we note carefully the direction in which the controlling screw is moved to bring about this DOWNWARD movement of the objective. We must keep in mind the fact that when we focus we ALWAYS focus upward first and that this screw must be turned in the opposite direction. It should be borne in mind that as we focus the camera see the objective and that should we focus blindly downward the objective migbt be forced into collision with the glass slide and we might break the objective. That is the reason a good microscopist always focuses his instrument upward.

The objective set in position, we now turn the light on and adjust it and the mirror (mounted in a gimbal) under the stage until a nice, even field of illuminating, not too bright, is produced as we look into the eye-piece or occular.

NOW we bring our eye to the eyepiece and set about making the focus. We must not press the eye against the eye piece and we must try to keep the other eye open. Working in a dark or darkened room will help although experience will teach that this is not necessy. It will be pure chance if, in placing the hair specimen on the stage, we happened to bring it directly under the objective. Consequently as we peek into the eyepiece we shall have to manipulate the glass slide until the bair is brought under the objective.

We must remember that motion is magnified too and if we see wbat looks like a telegraph pole being swept away by a 100-mile an hour hurricane, we shall know that that is the hair. Also remember that objects move in the direction opposite to that in which they are manipulated. We shall discover all of these things in trying to bring what turns out to be a bighly animated hair into our field of vision.

Once the hair is in place, we proceed to sharpen the focus, taking care to turn the knurled adjusting screw very carefully as the image sharpens up. A little practice will greatly increase *(Continued on page 94)*

WHAT YOU CAN DO WITH A MICROSCOPE

(Continued from page 93)

our enjoyment and as time goes on we shall find that we can manipulate our specimens so that we can bring any part of them under the objective.

Good practice in focusing can be obtained with a loosely woven fabric; a handkerchief might do. It is placed over the stage (slip glasses might be used but they are not absolutely necessary) and the instrument is focused according to the directions just given. If the fabric is not pulled taut, it may be found that one side of it is in focus while the other side is out. Small distances and irregularities in surface cause this. Now we can say that the slip glass would have prevented this had the fabric been pressed between two.

AFTER we examine the great pieces of rope that go to make up our handkerchief, we may pass on to a piece of greased paper. Here we shall find many things about paper that we did not know. It looks like a matted bunch of fuzz under a good instrument. We shall also find that we will be able to pass enough light through a piece of tissue paper to study its structure. Indeed for our first lesson, we can find many things about the household that will transmit enough light to give us a squint at them. An onion skin makes a good subject. So does a piece of apple skin scraped thin. Some good ripe vinegar supplies a rather interesting case of D.T.'s. The snakes in this innocent appearing liquid are plenty and large! In examining the vinegar, we use but a single glass and place a drop of the liquid on it.

In this first installment we can do little more than take in the first principles of microscopy. We shall just be entering the portals of an unendingly new and fascinating world. There remains much to be seen, much to be done as we shall later discover.

In putting the microscope away let us be careful to see that no trace of moisture is left on it. It should always be returned to its case to prevent dust from settling on and possible damage by being knocked over.

IT MAY surprise you to know that some of the world's greatest microscopists started as amateurs and mastered the fascinating art by patient work in their homes. Next month, Borden Hall will guide you further along the exciting path that leads into the unseen world around you. See Popular Science Monthly *for January, on sale December 1.*

OLD YELLOW GAS FLAME AGAIN PUT TO WORK

Useless except for illumination were the flickering yellow flames of the first gas jets. It was not until Robert Wilhelm von Bunsen, famous German chemist, discovered the secret of mixing air with gas to produce the blue flame that bears his name that gas became the servant of man for heating purposes as well as for lighting homes and streets. Strangely enough, science and industry are now turning again to the flickering yellow flame which is regaining its lost prominence under a new guise known as the "diffusion flame" for certain industrial applications, as in open-hearth steel furnaces, according to a report issued by the American Gas Association.

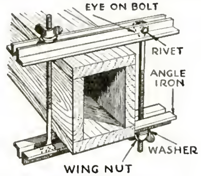
The new "diffusion flame" is yellow, long and flat. It may be produced by rows of alternate air and gas slots in a special burner. Although its temperature is lower than that of a blue Bunsen flame, tests show that it actually has a faster rate of heat transfer in many high-temperature operations, because of the increased proportion of energy emitted as radiant heat. It also maintains more uniform combustion in the furnace.

HE'LL BE GLAD YOU GAVE HIM POPULAR SCIENCE

It's one gift you can't measure by price, and here's good news—this year the price is lower than ever. Turn to page 91 and see the special rates for readers.

SHOP CLAMP IMPROVISED FROM OLD BED RAIL

STRONG and useful workshop clamps can be made as shown from a length of angle iron taken from an old bed frame. Cut this into four equal lengths to make two pairs. Also prepare two long threaded rods, each with an eye bent at one end. To assemble the clamps, drill a hole near one end of each of the pieces of angle iron, place the eye of one of the threaded rods between two of the angles, and fasten loosely with a bolt or rivet. Do the same with the other pair. Either wing nuts or ordinary nuts will serve for tightening the clamp, provided a large washer is used under them. This clamp is fully adjustable and holds irregular shapes.—E. C. Bonn.



This strong steel clamp holds both square and irregularly shaped work

TEXTILES WATERPROOFED IN METALLIC SALTS

When it is necessary to waterproof canvas or other textiles, the following method will be found to give especially satisfactory results: About 17½ pounds of aluminum sulphate, blue vitriol, or stannous chloride, finely powdered, are placed in a large container. In another container about 10 ounces of oleic, stearic, or margaric acid or soap are mixed with 13 pints of alcohol, and the whole is gently heated and stirred until dissolved. Then this solution is poured on the fine powder in the other container, and the mixture is kept under constant stirring at a temperature of 104 deg. Fahrenheit until it forms a solid mass. To waterproof any cotton or linen textile, a mixture of 1 part of this mass by bulk to 100 parts of water is made, and the material is drawn through it. For waterproofing silk or woolen materials, the mixture should contain 200 parts of water to 1 part of the solid mixture. After the material has been drawn through the liquid, it should be spread out until dry.—E. W.

Wanted . . . from Model Railway Fans

short articles, hints, and suggestions of interest to all those who have a miniature railroad system or intend to build one. Each item should be illustrated with one or two clear photos and, if necessary, a pencil sketch. The text should not exceed 200 words. Payment will be made upon acceptance for all available material.

ULTRA-VIOLET LAMP FOR "BLACK LIGHT"

(Continued from page 75)

current may be turned on, the carbons adjusted, and you have "black light"! There should be no light at all until some object is placed in the path of the invisible rays.

There are thousands of substances which glow, or fluoresce, under the rays of the "black light." One of the best for testing your light and for demonstration is vaseline, which glows with an intense electric blue. A solution of ordinary quinine tablets (quinine sulphate) in water also shows a fine blue. A piece of fluor spar glows as strongly as its name would suggest. Calcite also has a strong reaction and will continue to glow for a few seconds after it has been taken out of the path of the ultra-violet rays.

Finger nails fluoresce, so do teeth (if natural), scars on the body, stains on clothing, alterations in documents, and erasures on checks or other papers. Retouching of old paintings, repairs to rare postage stamps, and even forgeries can be detected.

It must be remembered that ordinary glass cuts off most of the ultra-violet, so if you are using an old lantern-slide projector all glass condensers and other such lenses must be taken out. Some substances will fluoresce under "black light" even if in ordinary glass containers, but better results are obtained if they are either exposed directly to the rays or held in quartz.

Do not allow the ultra-violet light to shine directly in your eyes. If you work with the light for more than a few minutes at a time, a pair of goggles with amber glass should be worn.

For a detailed explanation of how "black light" is used by scientific detectives, refer to the article "Weird Unseen Rays That Master Crooks" in the October, 1931, issue of Popular Science Monthly, *page 36.*

COSTLY LOOKING BRIDGE SET HOLDER

(Continued from page 74)

by setting the saw to cut exactly ¼ in. deep with the fence set 5/16 in. from the far edge of the saw cut. By successive cuts, trim out the waste wood outside of the initial cut. Any roughness left by the saw may be removed with chisel or file.

The use of casein glue is recommended in assembling the boxes, as it allows plenty of time for clamping up before it sets. For extra strength, let it a little thicker than called for in the directions on the package.

The clamping may be done with the usual clamps as shown in one of the photographs, but better results are possible if the gluing jig illustrated is constructed. A flat board about 6 in. wide bas an accurately squared block bolted to it at one end. Through this block extend three clamping screws—in this case relics of cheap, broken C-clamps. Extra holes at different levels allow the application of pressure where desired. Nuts made from the threaded portions of the clamps are countersunk in the front face of the block. Ordinary bolts threaded full length may also be used. A backstop is bolted to the base at the proper distance to take in the work and the necessary clamping blocks as shown. A series of holes in the base about 1 in. apart allows complete adjustability. One bolt of each pair clamping the head and backstop should be long enough so that it will extend upward through a 2 in. wide strip, and by means of these it is possible to exert downward pressure at each end of the work being glued up. *(Continued on page 97)*

For The Home Owner

Interested in Providing Healthful and Comfortable Air Conditions in his Home

A Bulletin on Air Conditioning for the home, which Popular Science Institute has prepared, describes complete central heating and cooling systems, and various types of units available for humidifying, for cooling, and for circulating fresh, dirt-and-pollen-free air throughout the home.

Regardless of what type of existing heating system you now have, you will find listed air-conditioning equipment for use in conjunction with it. You may wish to provide your entire home, or only one or two rooms with conditioned air. You may prefer equipment of the type that is installed out of sight in the basement, the recessed-wall type, or attractive cabinet-type units that harmonize with the decorative scheme of the rooms in which they are used.

Details regarding the equipment best suited to the requirements of your home, will be found in this bulletin, copy of which may be procured by sending six cents in postage, to cover cost of mailing, to Popular Science Institute, 381 Fourth Avenue, New York City.

COSTLY LOOKING BRIDGE SET HOLDER

(Continued from page 96)

The initial gluing operation on the side and center boxes is illustrated. After they have set overnight, the remaining sides should be given a final fitting; then the gluing may be completed with the aid of the same jig.

Trim the glued joints with a block plane, and sandpaper the work thoroughly all over. Set the ligbt piano binge entirely into the bottom piece of tbe side box and screw it to the center box.

Cut out the handles from aluminum or monel metal, and bend them as shown. The 1/8-in. material may be cut with either hack saw or jig saw. If with the latter, it will be necessary to slow down its speed to about 750 R.P.M.

The bending may be done by hammering in a metal vise, using a block of hardwood to protect the soft metal from hammer marks. Six steps in the forming of the catch are sketched in the drawings. It will aid in obtaining a sharp, accurate bend if you mark the location of each bend on the inside with a ligbt V-cut made with the cold chisel. After the catch has been completely formed and the corners squared up with a file, it will be necessary to open it up slightly in order to slip it in place over one of the handles.

Before finally putting the metal work in place, it should all be gone over with a smooth file and sandpaper to hring it to a satin finish, free from deep scratches. This finish should be protected with clear lacquer.

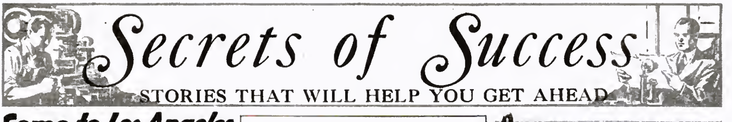
If it is intended to have the metal work chromium plated, which would be desirable although it would add to the cost, copper should he used instead of aluminum and the work brought to a high polish before the plating operation is attempted.

The surface of the lace wood should be filled with unstained paste wood filler, but the rosewood should be treated with filler that has been darkened with walnut stain. A sealing coat of thin shellac may then be applied and sanded down. After that a first coat of rubbing varnish or lacquer should be put on and leveled down with fine sandpaper, lightly applied. The final coat of varnish or lacquer should be rubbed down with finely powdered pumice stone and oil. If a high polish is wanted, this may be obtained by further rubbing with rottenstone and oil.

LAPPING STRAIGHTEDGES

How to produce an accurate straightedge is well understood by machinists and toolmakers, but there are several points about the final lapping operation that are worth noting. If the lapping block is ground on a surface grinder of the horizontal spindle type (using edge of wheel for grinding), it will grind a slight concave; if it is ground on a surface grinder of the vertical spindle type (using the face of wheel for grinding), it will grind a slight convex. The former is due to the wearing of the ways, which should be scraped slightly convex hy way of remedy, and the latter is due to the slight tipping of the wheel in order to eliminate drag on the rear of the wheel. For a lapping block, the former is to he preferred because a concave lapping block will produce a true plane on a straightedge. One can readily see that if the object is rotated by a sweeping motion, the ends of the straightedge receive more lapping than the center as they cover a greater area; consequently, this compensates for the slight concave in the lapping block.

When lapping knife-edge straightedges, they cannot be held very readily edge to edge for testing. This difficulty can be overcome hy laying them on a piece of clear glass and holding them up to a strong light.—F.J.W.



Secrets of Success

STORIES THAT WILL HELP YOU GET AHEAD

HIS DESIRE TO KNOW "MADE" GUS WILSON

HE'S NOT famous, but every reader of POPULAR SCIENCE MONTHLY knows him well. You need no introduction to Gus Wilson, Proprietor of The Model Garage. For many years he has been giving the readers of this magazine the benefit of his experience as an auto mechanic.

What you don't know about Gus Wilson is his history, the story of the steps he took from early manhood up the ladder of success. This little biography is a simple one, and its chief value to young men looking for a future lies in the fact that Gus Wilson is not a famous man, not a great personality, or a public idol. He's an average citizen—just as we all are. His one outstanding characteristic is his desire to learn. Although Gus knows his job from A to Z, he's smart enough to realize that he still doesn't know everything. Consequently he finds himself learning something new every day and that's what keeps him up where he is.

Let's begin at the beginning. Gus Wilson (we've given our word not to print his real name) literally grew up with the automotive industry. While Duryea tinkered with his first gasoline buggy, Gus Wilson, then a young man, was investigating and overhauling those ancient little steam cars that used to stop at every horse trough so that the driver, by means of a hand pump and a length of hose, sucked gallons and gallons of water into the tank.

When electric hansoms groaned their slow way over the streets of New York, Gus was giving first aid to batteries and sandpapering the commutators of many a motor. Somewhat later, the huge one cylinder engine of an old Northern runabout (remember that car?) kicked back on Gus and broke several wrist bones. His wrist is still a little stiff.

SINCE then Gus has worked on almost every type of automobile ever made. Every chance he got, every spare hour he could snatch, was devoted to learning more about the queer kinks and odd points of an automobile. He studied to become a qualified mechanic, learned machine shop practice and automotive electricity. He wanted to know automobiles, know them so well that no car trouble would ever stump him—and he does.

Over that long stretch, Gus had been saving steadily, and with a purpose. The day one of his bosses decided to get out of the garage business, Gus stepped in and bought out his partnership. Today, his garage, located in New England, lives up to its name. It is a model of efficiency in service and of honesty in operation. Now, in addition to service and repair work, Gus has the sales *(Continued on page 100)*

ARE YOU "SET" TO START THE RACE TO BETTER TIMES ?

The TRAINED MAN always Wins!

It's just as true—or even truer—in business as in sport. The man with real, practical TRAINING is the one to win. Now that business is returning to normal there's going to be a harder race to win the prizes of big-pay jobs, independence and a future, than ever before. Are you "all set" to race? Have you the necessary TRAINING to bring you in among the winners! If not, DON'T WAIT! Get the training NOW while there's still time!

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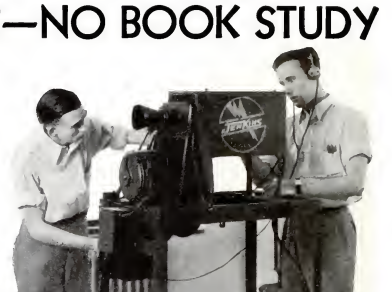

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Secrets of Success

HIS DESIRE TO KNOW "MADE" GUS WILSON

(Continued from page 98)

agency for one of the best known cars on the market. In his community he has gained an enviable reputation for dependable service and square dealing. People in his town will tell you that Gus never turned out a faulty repair job.

Gus Wilson started with the automobile. For young men who want to get ahead, there are similar fields of mechanical appeal that are now in their infancy, and that offer the same broad opportunities the horseless buggy did when Gus was a lad. Television, aviation, talking pictures, air conditioning need men of Gus Wilson's caliber. And there is always plenty of room for another good auto mechanic and radio service man.

• • •

THIS INVENTOR COULDN'T READ AT TWENTY-ONE

OVER 2,000 practical patented inventions to his credit, but he couldn't read decently until he was twenty-one years old! That's just one interesting side light to the amazing career of Ethan I. Dodds, next to Edison, the world's most prolific inventor.

All these patents have been taken out in the last twenty-five years, which is at the rate of one every four days or so! Yet the man who conceived them couldn't read fluently until he was twenty-one and was dismissed from a small college one week after entering. "I'm sorry, Dodds," the college president told him, "but we can't do anything for you."

The college president was probably right. His institution could not have improved upon nature, which had endowed Dodds with unusual inventive genius. When he was a barefoot boy of seven, sent home from a little red schoolhouse near New Galilee, Pennsylvania, because he could not learn his A B C's, young Ethan developed his first invention. He heard his mother complain as she rubbed her aching arms after laboriously stirring apple butter with a big wooden ladle in a copper kettle. So he hitched a miscellaneous assortment of belts and pulleys to her rocking chair, and thereafter Mother Dodds made the smoothest apple butter without rising from her favorite chair or even looking up from her knitting.

At seventeen, he left home and his father's small coal business, and went to work as a blacksmith in the Westinghouse works at Pittsburgh. Here there was no keeping his inventive mind under cover. Soon he became George Westinghouse's right hand man, and when Marconi came to Westinghouse with his first models for wireless, Dodds was assigned to help him.

For all his inventive genius, Dodds found it necessary to study, to learn mechanical and engineering principals; to eliminate *(Continued on page 101)*

Secrets of Success

THIS INVENTOR COULDN'T READ AT TWENTY-ONE

(Continued from page 100)

useless efforts and to strive always for the practical. He had the foresight to see that study of methods and of records would speed up his work and direct his ability into rapidly moving channels. He found that studying and research work, that helped broaden out his inventive work, paid good dividends.

After leaving Westinghouse, he become associated with E. H. Harriman, the railroad magnate, who built a laboratory for him beside his own home at Central Valley, N. Y., so the inventor could be at his call any time. Dodds still lives there.

WHEN you make a night trip in a Pullman berth, thank Ethan Dodds for the fact that you don't have to sit up all night. He invented the all steel sleeping car. Incidentally, when you switch on the light in that berth, you are using another Dodds invention.

Among his latest inventions are an emergency's miners' lamp which stores "cold light" for two and a half hours, and the portable, electrical circular handsaw now generally used by most carpenters and cabinet makers. An idea of his versatility may be gained from one of his methods of invention. When a company finds that its products are going out of favor and they are faced with making changes or going out of business, Dodds is called in for consultation. He looks over the equipment and machinery in the plant and then sets to work inventing an entirely new product that can be made with the old machinery!

Cash Prizes

Awarded For All True Success Stories Accepted and Printed

THIS department will give $5.00 for every true success story submitted by readers of Popular Science Monthly, and which is accepted for printing in this magazine.

Manuscripts will be judged on the individual merits of the case and circumstances involved. Only stories in which the author's success, or that of some one known to the author, has been gained by some method of educational guidance, fitness for the job, or application to the work will be considered. We are not looking for the "get-rich-quick" type of story.

Manuscripts must be confined to 500 words or less. They must be true and, if accepted, authors must be prepared to give us signed statements to the effect that they are true. Manuscripts submitted and printed become the property of this magazine, and we are not responsible for the return of rejected stories unless postage is provided for this purpose. Address contributions to Success Story Department, Popular Science Monthly, 381 4th Avenue, New York City.

HOW TO SET UP A Sand Mold

for casting metal at home

BY JOSEPH C. GILBERT

Pouring a mold made from patterns seen in foreground. Compare with drawing *D* below

ALUMINUM and other alloys of a low melting point are preferably the metals with which the model maker or experimenter should begin when learning to make small castings in the home workshop. The equipment for this work has been described in two previous articles (P. S. M., Oct. '32, p. 93, and Nov. '32, p. 96).

After you have become accustomed to handling molten metals, a heat of bronze or brass may be taken. In melting these, poke a hole in the coal for the crucible. Wear leather gloves and blue glass goggles and keep a gangway clear between the fire and the mold. In case of a burn, the foundryman's method of relief is to apply sweet oil, although linseed or luhricating oil will do if the other is not at hand. Keep away from water or cold air, and after the oil application cover the burn with a paste of flour and water.

With all the necessary equipment at hand, there are still several important things that the novice must hear in mind. First, the pattern, if irregularly shaped, must be examined so as to trace the joint line, or part-off, between top and bottom.

Castings as taken from the mold and as they look when assembled (lower right-hand corner)

For example, an anchor for a ship model would be sliced through the center to make two halves. One half is bedded into the drag, the other protrudes above the joint into cope, which will lift off clean. In drawing the pattern out of the drag, if properly jointed, the impression of the pattern will be perfect and there will be no broken edges in the drag. With a little practice on flat or plain work, the beginner will quickly grasp the method of handling this work.

Sand is another item which cannot be slighted. It must be dampened to the proper consistency. If too dry, the mold will crumble and drop out; if too wet, the

Views showing how a sand mold is prepared. The drag is rammed as at *A* and turned over; the cope is added as at *B* and rammed; and the mold is finished and set up as at *C* and *D*

sand will cause sticking on joint and pattern. A wet closed mold makes bad castings. When molten metals are poured into wet molds, steam is generated and may blow the metal violently out of the mold, which is exceedingly dangerous.

A GOOD rule for mixing sand is to add very little water at a time. Spread the sand on a piece of brown paper a yard square, sprinkle a little water all over it, and turn it over and over with both hands, rubbing dry into the wet between palms and fingers so that every grain may obtain its share of moisture. This done, gather it into a heap. To test it, grab a handful, squeeze hard, open the hand, and try to pick up the lump of sand from one hand with the other, or roll it from one to the other hand without breaking. This will indicate whether the sand is fit to mold. If in squeezing it makes the hand so wet as to show a film of water, it is too wet. To overcome this, add a little dry sand. Keep a tomato can full of dry sand for such use. On the other hand, should the lump of sand crumble in picking it up, the mixture is too dry and would drop out of the cope.

When the sand has been properly mixed and placed in the bin, set the drag, joint down, on the mold board and place the pattern in such a way as to leave ample room for the gate and sprue at one end as shown in the drawing at *A*.

SIFT sand over the pattern in the drag to cover an inch or two. Then fill up to about 2 in. above the top edge of the drag. Start ramming around and near the sides with the peen end of the rammer. Peen around and around from sides to center, adding more sand for a hard butting down. Strike off the surplus sand even and smooth with the top edge of the drag. Rub on the board and turn the drag over. This is done by putting one hand under the mold board, the other on the upper board; and with both hands pressing against one another, the mold is lifted and turned.

With the removal of the mold board, the joint should have a hard, smooth surface with the edges of the pattern clearly shown all around. Parting sand is dusted on the joint, then gently blown away from the surface of the pattern. The cope is put on as at *B* and rammed up the same as the drag; then it is vented and the sprue punched as at *C*.

The board is next rubbed on the cope, which is gently and evenly lifted off the drag and set on its side for reaming out the sprue hole. After this has been done, it is set aside until the pattern is gated to the sprue, swabbed and rapped, and drawn from the drag with great care so as not to break the edges.

Provided the mold is perfectly clean, the cope is again set on the drag with the board slid down until the edge clears the sprue by about ½ in. as at *D*. The whole is then clamped together firmly and set at an angle as shown. Push the wedges under the toes of the clamp with the hands only. Do no hammering of any kind as it may cause drop-outs. Closed molds must be handled gently and carefully.

The metal can now be poured as shown in one of the photographs. A stove poker is used to skim back the dross.

Our CONSTRUCTION KITS

Save Time and Money

KIT NO. 4

KIT D

KIT NO. 1

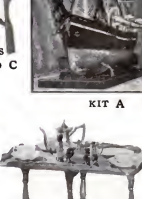
CONSTRUCTION kits of materials for building a 3 ft. long exhibition model of the U. S. S. *Texas*, flagship of Battleship Division I and one of the most powerful battleships, have been assembled under the supervision of the Popular Science Homecraft Guild. Each kit contains the necessary wood, sheet brass, wire, rods, brass tubing, chains, beads, nails, escutcheon pins, and other materials—in fact, everything but the paints. (If it is desired to install a power plant in the model, the machinery, of course, will have to be obtained separately.)

The price of the kit, sent postpaid to any address east of the Mississippi River, is $6.95. For 50 cents extra, you can also have the five main hull pieces or "lifts" sawed to the correct shape, if you do not wish to draw the necessary patterns and do the work yourself. This new kit is marked *E* in the list below, which gives all the kits now available. Instructions or blueprints accompany each one.

KITS B AND C

KIT A

NO. 2



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No. 2. Solid mahogany tray-top table 23 in. high with a 15 in. diameter top. Ready to assemble..... 5.00

No. 3. Tilt-top coffee table in selected maple with top 19 by 28 in., and 21 in. high. Ready to assemble..... 7.15

No. 3A. The same table in solid mahogany. Ready to assemble..... 8.15

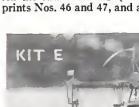
No. 4. Solid mahogany book trough 22½ in. long, 9½ in. wide, and 24¾ in. high over all. Ready to assemble..... 5.30

A. Whaling ship model *Wanderer*. All the raw materials—wood, wire, fishing line, chain, celluloid, and everything but the paints, together with Blueprints Nos. 151, 152, 153, and 154. The hull is 20½ in. long..... 6.90

B. Folding muffin stand in selected sugar pine, 11 in. wide, 19 in. long and 33 in. high when open. All the necessary wood cut to approximate sizes but not machined... 2.90

C. Same muffin stand in birch (can be finished as maple, walnut, or mahogany) 2.90

D. Spanish Galleon ship model, 24 in. long. All the raw materials (except paints), Blueprints Nos. 46 and 47, and a booklet.... 6.45



KIT E

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BLAST OF GIANT ATOM CREATED UNIVERSE

(Continued from page 29)

fine mist much as droplets of water condense in a rain cloud. Although this theory, the well-known nebular hypothesis, has long since been abandoned so far as the origin of the earth and solar system is concerned, astronomers have been inclined to accept it in explaining the birth of stars.

One intuitively feels that the self building up of stars from cosmic dust is a process that would take an infinitely greater time to complete than the mere formation of planetary systems—a feeling that precise calculation confirms. If the expanding-universe conception is correct, we must revise our ideas about the birth of stars. Slow evolution is out of the question. A fireworks theory is exactly what we need!

DR. LAMAÎTRE'S hypothesis does away with the old query as to the state of affairs before the beginning of things. Going back to the parent atom we may inquire about what happened before the cosmic explosion took place. The answer is: "Nothing." Computation shows that space would have closed up around the massive atom and, certainly, nothing can happen where there is no room for it to happen. Time has no meaning in a perfectly static world. The age of the universe is to be reckoned from that prehistoric Fourth of July, when space came into existence. Since then, space has been continually expanding before the onrushing stars, sweeping the way for them, forming a sort of motorcycle squadron to make room for the star-procession to follow.

Lemaître's theory does not tell us how our earth was formed,—whether the planets were born at the time of the original explosion or whether they came into existence at some later date. If his hypothesis is true, however, it is more attractive to believe the former, speculative as it may be. At least this assumption will provide consolation for those who have lamented the failure of the generally accepted theory to provide for more than a handful of possibly habitable worlds.

SO MUCH for the present. What of the future? Einstein and the noted Dutch astronomer, Willem de Setter, have talked of some future contraction, which might sweep up the stars along with cosmic dust and eventually bring the world back to its original state. Dr. Lemaître thinks that such a contraction cannot occur. He prefers to believe that the whole universe was born in the flash of a cosmic sky-rocket and that it will keep expanding until the showering sparks which form the stars have burned to cinders and ashes.

SINK SHIPS IN OCEAN TO ATTRACT FISH

SOWING the bottom of the sea along the coast with sunken ships is a novel plan for building up new fishing grounds advanced by Harry M. Armstrong, treasurer of the New Jersey Fish and Game Commission. Wrecks always attract small marine vegetable and animal life, which in turn attracts fish. By towing abandoned ships out to the three-mile limit and sinking them, Armstrong says, valuable new fishing grounds could be built up.

SEVEN-FOOT FLOWER GROWN IN HOLLAND

ONE of the largest flowers that ever bloomed on earth opened recently at the Agricultural High School at Wageningen, Holland. It was an arum lily seven feet high and three and a half feet across. The blossom lasted two days.

NEW PLANT WIZARD RIVALS BURBANK

(Continued from page 45)

In his work with gladiolus, Henderson was aided in the task of cross-breeding in an unusual way. In his part of California, the Egyptian Moth, a nocturnal insect almost as large as a bumming bird, is common. These moths are particularly fond of the nectar from gladiolus and flew from the common to the wild variety which he had planted side by side in his garden, carrying the fertilizing pollen with them.

While he was still at the Burbank gardens, he had begun his experiments with this scentless flower, seeking to give it a delicate perfume. Hearing of a wild gladiolus in South Africa, called the "Gladiolus Tristus," which gave off a delightful fragrance at night, he sent for seeds. These he planted in his Fresno experiment garden beside rows of the common variety of the flower. By cross-pollenating, as well as by permitting the night moths to assist in the work of fertilization, he produced a new flower which, with each successive generation, possessed more and more fragrance, a delightful scent like the aroma of gardenias and orange blossoms combined.

ANOTHER accomplishment to which Henderson "points with pride" is his Abundance sweetcorn. It is a development from the Golden Bantam corn. The chief improvement in the new variety is the increase in the number of kernels. The Golden Bantam usually has only eight rows to the ear. By selecting seed from corn of this type which showed a tendency to more rows, and by repeating this process over a number of years, he has developed a new corn that has sixteen rows and a much longer ear. At the same time, the kernels have retained their tenderness and high sugar content.

Someone has jocularly remarked that: "There is some good in everything, there being no hopes in spinach." Henderson has produced another commendable quality, added attractiveness in color. By crossing Swiss chard with sugar beets, he has developed a new variety of greens with brilliant red stalks and red veins in the leaves. This coloring remains even after the chard is cooked adding to the attractiveness of the dish on the table. At first, the result of the cross-breeding was plants of innumerable color combinations in leaves and stalks. But rigid selection over several years produced a type which comes true from seed.

BESIDES its unusual coloring, the new plant, known as the Crimson Giant chard, is a profuse grower with unusually large leaves. Three or four plants, Henderson calculates, will supply an average family with succulent greens for a season. Instead of going to seed in three or four months, as formerly happened, the new chard develops seeds only once in two years.

Just before his death, Burbank was trying to produce a rose of unusual color and extreme fragrance combined with ability to stand heat and severe weather changes. Henderson's experiments with roses have been along these lines. He has a wild rose which he uses for hybridizing purposes, putting the varied colors of tame roses into the wild one. Among the colors thus far produced are a dark, velvet red edged with black; silver pink; orange; pure scarlet, and a yellow and bronze combination. Public taste in roses, during recent years has run to vivid, brilliant hues, and Henderson has endeavored to satisfy the demand.

Most of his experiments are carried on with a definite goal. Canners ask for a stronger skin, a sweeter flavor, or a larger size in a certain fruit. Henderson sets out to produce the desired improvements. Florists seek certain colors in certain flowers. Henderson works to supply them. But occasionally he makes an experiment without the slightest idea of what will result, "just to see what comes of it." One test of this sort is going on now. It is the union of the pepper, the potato, the tomato, and a yellow plant similar to the jimsen weed. All four belong to the same family. But what the combination will produce, no one can predict.

In his work, Henderson imports new plants and trees from many lands,—Australia, Siberia, South Africa, Japan, England, Turkestan, and elsewhere. From Africa, came a scarlet wistaria tree; from Chile, a giant trumpet vine that blooms three times a year; from Siberia, ornamental crabtrees, and from Japan, evergreen pears.

One of the strangest experiments he is carrying on is an effort to produce a peach with a pit flavored like an almond. Such a fruit-nut combination was first considered by Burbank many years ago. He attempted to cross the stoneless plum, the peach, the nectarine, or smooth-skinned peach, and the almond. Ordinarily, the peach and the plum do not cross. Burbank obtained one such hybrid, but it was not a success. It never bloomed.

HENDERSON believes it might have been successful in a warmer climate such as Fresno's. Sudden climatic changes often produce great differences in plants. The rhubarb, for instance, grew only in seasons in its native country, Australia. In California, it became an evergreen, producing the year around. At his Fresno farm, Henderson is grafting scions from stoneless plums onto peach trees to reduce the size of the pit and the thickness of the peach-stone before going on to the next stage and crossing the peach and the almond. The final result, he hopes, will be a large and luscious smooth-skinned peach with an almond-flavored kernel.

SWIFT RIVERS OF AIR FLOW IN STRATOSPHERE

HORIZONTAL rivers of air, moving rapidly in various directions through the stratosphere, were discovered by Prof. Auguste Piccard during his second ten-mile ascent above the earth in an air-tight globe last August. The discovery, following prediction of such high-altitude currents, is announced in a recent report by Max Cosyns, Prof. Piccard's assistant on the spectacular balloon flight over Switzerland and Italy. Its importance is great to sponsors of high-speed planes designed for travel in the stratosphere, where a pilot could take advantage of the air streams to add to his speed. Another interesting observation during the latest Piccard flight was the absence of air pockets or eddies at the highest altitudes. At this writing, the data obtained regarding cosmic rays are still being checked and interpreted.

BONES OF RARE BEAST FOUND IN MONTANA

EXCITING news to fossil-hunters was the recent announcement of Barnum Brown, dinosaur expert of the American Museum of Natural History, of the outstanding discovery of the year by any expedition in this country. The Montana find was a complete skeleton of a dinosaur known as "horlitosaurus," a creature so rare that only a handful of bony plates have hitherto testified to his prehistoric existence. The newfound skeleton shows he was fourteen feet long, and seven feet wide. Heavy armor plates of bone covered him.

HOW ONE MAN BUILT A $50,000 HOME

(Continued from page 47)

of oak that bear carved designs. These have been treated with creosote to preserve and color them. Over the windows are chestnut wood lintels, some of them partly-carved.

Even the impressive corkscrew chimneys, one with two flues and the other with three, bear evidence of special treatment. The builder made the caps in his studio room, incorporating iron ore in the concrete. When this was exposed to the weather, the iron oxidized, producing the desired aged effect. This little stunt is worth remembering by anyone who likes to produce unusual effects with concrete.

A radio sound expert visited Sommer one day, and remarked at the unusually perfect acoustics in the great studio room.

Sommer plans to install a pipe organ in the studio some day, when other work is completed. There is ample space for the organ mechanism in an adjacent attic.

IN MAKING light fixtures, door knockers and other metal accessories himself, any home-huilder could save numerous pennies. But such fittings at the Sommer home *had* to be handmade. Machine-produced lamps and hardware would be as much out of place in the atmosphere of Old England as a modernistic chair. So Sommer went to work at his basement forge and anvil. From a ruined mill nearby, he obtained an iron band that had kept the mill wheel shaft from splitting. This he fashioned into a chandelier by adding candle holders and supporting chains. Other lighting fixtures, door knockers, hinges, and catches claim the same origin.

The use of ordinary furniture would not be in keeping with the true spirit of the house. So Sommer has made many of the pieces with his own hands. In the hreakfast nook is a sturdy oak tahle, made in the true Old English manner. There are benches of the same period; chairs and other pieces. The collection is increasing steadily, for the furniture is as much a part of the house as if it were built in, and must grow with it.

Although the house has been in the progress of construction for four years, it by no means has been useless during that period. When only a heavy canvas served as a roof for the breakfast nook and kitchen, Mr. and Mrs. Sommer moved in. As the house grew, their living quarters expanded until eventually they occupied the entire structure. This method, like many others associated with the house, has its economical features.

It is not likely that many persons can be found who would tackle so ambitious a project as building a house like the Sommer residence. But the method can be applied to anything from a cottage to a castle.

IF THE house is to be right in proportion and plan, there is one economy that may not be recognized at first because it looks more like extravagance: that is, the calling in of a competent architect. Although Sommer had planned his English house since he was sixteen years old—he is thirty-two now—he discovered that his final plans were not entirely correct. When he consulted an architect, he learned that his studio room was in the wrong place, and that several other details were not right from an architectural standpoint. These imperfections were corrected, and the result is a structure that is more pleasing in appearance and more easily lived in than if it had been constructed without the expert advice and aid of an architect.

If a man can erect a $30,000 house at a cost of only $8,000, he has saved $22,000. And if he takes four years at the task, he is actually earning more than $5,000 a year, because the old saying that "a penny saved is a penny earned" still holds good.

SEE PAGE 91
For The Christmas Gift Every Man and Boy Wants

SHARPSHOOTING AT TARGETS FROM PLANES IN THE CLOUDS

(Continued from page 42)

dives on each target. On gusty days, when for only a split-second the plane is steady, the best scores are made by firing short bursts of half a dozen bullets at a time.

We are in position for another try. Nichols peers down the sighting barrel, a long black tube, with bead and peep sights, pointing straight ahead on the cowling before his windshield. By means of it, he aims his ship at the target. His machine gun, on the right side of the cowling, shoots slightly to the left so the line of fire and line of sight converge 200 yards ahead of the plane.

On every dive, Nichols peers along the barrel with one eye partly closed but *never entirely shut*. The reason is simple. As soon as you close one eye, you lose accurate depth perception. You are unable to judge your exact height above the earth. What may happen when this rule is violated is illustrated by the experience of one pilot at Aberdeen only a few months ago.

HE WAS diving in a Falcon on a bumpy day. In his struggle to keep the bead on the bullseye as he came in, he closed one eye. Before he knew what had happened, the ship crashed with a report like a cannon shot. He had flown into the ground at eighty miles an hour. Fragments of shattered wings strewed the ground for a hundred feet and the engine, twisting from the fuselage, rolled like a tumbleweed ahead of the plane. Yet, by one of those miracles that sometimes come to the aid of airmen, neither the pilot nor observer was killed.

On our second dive, Nichols gets in a volley of a dozen shots, and a tracer bullet ricochets twenty feet into the air like a fiery red rocket. Every fifth bullet is a phosphorus-filled tracer. One of them, a few weeks ago, glanced from a rock fifty feet in the air, passing between the wings of the zooming ship at the top of its arc. Another time, three ricochets at once, like red sparks from an anvil, and the pilot had to twist like a corkscrew to avoid them.

In dry weather, tracers sometimes start grass fires around the targets. Then, the ground crews flip open their pails of sands to black and make a dash to stamp out the blaze. One tracer-fire of this kind recently produced the prize hard luck story of the field. A pilot was sure he had riddled the bullseye and was due a record score. Then, his last tracer started a grass fire and three-fourths of the target burned up before the ground crew could save and score it!

SEVEN times we dive on target number one. Then, the fifty bullets allowed for it are gone and we begin on number two. Each target has to be approached in a different manner. On number one, you dive straight across the two lines. On number two, you make a right-hand turn and on number three a left-hand turn inside the 1,000-foot line and head for the mark. On number four, you approach from the rear of the target, make a sharp half-circle inside the 1000-foot line, firing as you head back.

Our first belt of ammunition is nearing the end. We wheel, dive, fire,—wheel, dive, fire. It is like riding a great roller-coaster, only a hundred times more thrilling. On each circle, our shadow races ahead over the woods and creeks as we swing away from the sun, then slinks back to fall behind as we turn about, facing it again. On the Pacific coast, "shadow planes" are used for targets in machine gun practice. The pilots fly out over the ocean and the gunners try to hit the shadow, splashes in the water showing where the bullets strike.

A deserted stretch of ocean is also usually the scene of the spectacular "towed target" practice. The Fifth Observation Squadron, when it is stationed at its base, Mitchel Field, L. I., heads out over the Atlantic off Point Lookout for the work. The target is a light cloth "sleeve" or "sock," about twenty feet long, suggesting an airport windcone. A black band around the middle forms the bullseye.

While a towing plane sails through the air at the end of a long steel cable, the attacking ship, diving or zooming toward the sleeve, tries to riddle it with bullets. The attacks are made in two ways, diving from the rear or zooming up under the target from the front. In the latter method, the sleeve is going a hundred miles an hour in one direction while the attacking plane is traveling nearly as fast in the other. Consequently, the cloth mark streaks past the gunsights so fast only a crack shot can hit the bullseye.

AFTER towed target practice, the sleeve is dropped to the ground at the airport and the cable reeled in. A special weight that runs out on the cable trips a catch dropping the sleeve. Not long ago, three sleeves were dropped one after the other at Mitchel Field and every one landed on the roof of the highest hangar!

A pair of powerful wire clippers is always carried in the towing ship so the observer can cut the cable in an emergency. Sometimes, the weight which releases the target gets caught on the end of the cable. At other times, bullets cut the cords that hold one side of the cone's mouth to the cable and the sleeve starts to spin, whirling like a kite that has too short a tail. Over Point Lookout, Mitchel Field pilots had two sleeve spins in a single week recently.

In counting up the towed target score, the number of holes in the cloth is divided by two to determine the hits because a bullet passes through both sides of the cone. Sometimes a gunner is unlucky enough to shoot through the side at an angle that carries the lead out the open mouth. Then, he gets only half-credit for his hit.

ON OUR final attack on target number two, Nichols gets in three short volleys before we flash across the 400-line. With our cartridge container empty, we head low over the observation tower, the ship rocking from side to side as we waggle the wings as a signal we are going home.

Hollidge is making his last dive and the ground crew is climbing into a truck to go out and mark up the score. Around every bullet-hole they will put a pencil mark and make a record of its position. A bullseye counts five, an inner ring four, and an outer ring three. Instead of pasting a whole new target on the framework every time, they stick patches over the holes so the papers can be used again until they are riddled.

Halfway home, Hollidge creeps up on the left and the spine-tingling formation flying begins again. We come in over the bay in a steep sideslip and taxi to the starting line. Mechanics are waiting with fresh ammunition. We stretch ourselves while they reload the Browning. Red half-circles under our eyes, left by the goggles, give us an owl-like appearance. In five minutes, we are off again.

This time we work on targets three and four. Diving low over the treetops out of a sharp left turn, we blaze away for almost fifty rounds on number three. The air is smoothing out. Ground gusts are dying down. Shooting has become easier and the high staccato of the gun continues for longer periods at each dive. *(Continued on page 109)*

"GIMME ONE, *me sister's got it*"

A ragged, dirty newsboy blurted, "Gimme one, me sister's got it," and dropped on the marble counter* a single penny that tinkled lonesomely. He was buying one of the first Christmas Seals sold in the United States for anti-tuberculosis work. The need was great. He knew. His sister had it.

Today, Christmas Seals help protect you and your family, for although the death rate from tuberculosis has been reduced two-thirds it still kills more people between 15 and 45 than any other disease. Your pennies make possible free clinics, nursing service, preventoriums, and educational work that mean cure for some, relief for many, and hope for all.

*In the lobby of the Philadelphia "North American," Dec. 13, 1907

THE NATIONAL, STATE AND LOCAL TUBERCULOSIS ASSOCIATIONS OF THE UNITED STATES

BUY CHRISTMAS SEALS

Statement of Ownership, Management, Circulation, etc., required by the Act of Congress of August 24, 1912, of Popular Science Monthly, published monthly at New York, N. Y., for October 1, 1932. State of New York, County of New York, ss. Before me, a notary public in and for the State and county aforesaid, personally appeared A. L. Cole, who, having been duly sworn according to law, deposes and says that he is the Business Manager of Popular Science Monthly and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management, etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in Section 411, Postal Laws and Regulations, printed on the reverse of this form to wit:

1. That the names and addresses of the publisher, editor, managing editor, and business managers are: Publisher, Popular Science Publishing Co., Inc., 381 Fourth Avenue, New York, N. Y., Editor, Raymond J. Brown, 381 Fourth Avenue, New York, N. Y., Managing Editor, Raymond J. Brown, 381 Fourth Ave., New York, N. Y., Business Manager, A. L. Cole, 381 Fourth Avenue, New York, N. Y.

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(Signed) A. L. Cole, Business Manager.

Sworn to and subscribed before me this 27th day of September, 1932.

Esther Eyl, Notary Public, Kings County Clerk's No. 54, Registry No. 4059. New York County Clerk's No. 143. Reg. No. 4674.

(Seal) My Commission expires March 30, 1933.

SHARPSHOOTING AT TARGETS FROM THE CLOUDS

(*Continued from page 108*)

Nichols swoops for a final fusillade on the third rectangle and presses the trigger. Nothing happens. He jerks back and forth on the charging handle and comes around again. Still the gun is silent. Nichols pumps the handle half a dozen times. We circle for a third attempt. This time the balky gun goes into action like a triphammer, and puffs of dust shoot up behind the target to be scattered an instant later by the blast of our slipstream as we hurtle by.

An old cartridge with a swelled case had stuck in the gun. Usually, a pilot can clear such a "stoppage" by means of the charging handle. If, however, the mechanism of the gun becomes "jammed," he has to land and turn it over to the armament expert. Neither accident is considered serious. It is a runaway machine gun that brings the hair-raising emergency that every army pilot dreads. Such a weapon runs amuck, pouring out a stream of deadly lead that can't be stopped until the last cartridge is gone.

A WORN firing pin, a broken spring, or a loosened plunger nut, Sergeant Lester Light, the armament expert of the squadron explained to me, will keep feeding live rounds into the chamber and make the mechanism run away once the trigger has been pressed. Every day, after every firing, the guns are carefully inspected to prevent such accidents.

We have swung over to target number four. The most spectacular phase of the work begins. Racing toward the rectangle from the rear, we zoom into a high wingover between the white lines and come back, tail high and nose down, ripping lead and streaking tracer bullets through the mark.

In and out of shellhole pools, the reflection of our yellow wings flickers as we rush past. Half a dozen times, we race from back of the targets and zoom upward. Now we are coming in so low the landing wheels seem to rake the top of the target as we roar by. Nichols has got the range and is pouring lead in short bursts into the bullseye.

Then the gun stops working. Peering through round openings in the metal cartridge container, I see it is empty. The last shot has been fired. Harmon has already headed for home as our ship rocks from side to side and passes the tower.

At the home field, we climb stiffly out of the machine and unbuckle our parachutes. We are partially deaf from the thunder of the engine and our cheeks are stiff from the rush of wind. In the pilots' room, Capt. Harmon is at the telephone getting the record from the observers' headquarters. A placard, posted on the wall behind him, is labeled "Qualifying Scores."

IT LISTS the marks required for the three ratings. Out of the possible 1,000 points, a score of 438 gives a pilot the rating of Aerial Marksman, 615 Aerial Sharpshooter, and 788 Expert Aerial Gunner. Special insignia for the uniform and added pay are the rewards for crack shots in the air corps.

Harmon is jotting down figures and talking into the 'phone: "Lieut. Nichols' score. . . outer circles, seventy-six . . points, 228. . . right. . . inner circles, fifty-five . . points, 220. . . right. . . bullseyes, sixty-nine . . points, 345. . . . . right. . . . . score for the day, 793 points . . right!"

The other pilots crowd around with good-natured banter Nichols has made the "hot score" of the day, five points above the qualifying mark for the highest rating. At the end of the month's training, scores will be averaged to give the final rating.

"And to be high man," Harmon tells him, "all *you* need is a few more gusty days!"

ANTI-FREEZE PROBLEM IS SOLVED BY EXPLOSION AND FIRE

(Continued from page 64)

of the radiator and the heat in the water can't get through to be absorbed by the air. You ought to clean it out at least twice a year. Especially before you dope your cooling system for the winter.

"It's easy. All you have to do is buy a prepared radiator cleaner, dissolve it in the right amount of water, put it in the radiator, and then drive the car for about two hundred miles. When you drain it out all the dirt and sludge come with it."

"By the way, Gus." Gordon said, lifting the hood and pointing to the water pump. "My pump uses an awful lot of grease. Where does it all go?"

"RIGHT into your radiator," was the reply. "And it's the best little scale former there is. Half the dirt in your cooling system probably has come from the grease you've forced by the bearings on that pump. The answer is to use a waterproof grease and use it sparingly.

"But getting back to anti-freeze mixtures, why use alcohol?" Gus asked. "That went out of date with kerosene lamps."

"What's the matter with alcohol?" asked Gordon. "It does the job and it's cheaper than anything else."

"It's not so cheap when you stop to consider it," Gus insisted. "Alcohol boils at about one hundred and seventy degrees, so if you run your motor at the right temperature you have to keep strengthening the mixture.

With a solution of glycerin or ethylene glycol there's nothing to worry about as far as boiling is concerned. They may cost more for the first filling, but unless you've got a leaky radiator, the same solution is good for several years."

"Yes, and if your cooling system happens to have a small leak that you don't know about, you sprinkle the road with dollar bills," Gordon objected.

"Well, that shouldn't be any drawback," grunted Gus. "It's no job at all to find leaks and fix 'em. One thing lots of people don't realize, though, is that solutions expand when they're heated. If you use an expensive anti-freeze, don't fill the radiator right up to the top of the overflow pipe but leave a little room for expansion.

"The advantage of glycerine or ethylene glycol," continued Gus, "is that you can run your motor just as hot in winter as you do in summer without fear of having your anti-freeze evaporate."

"How would I make up a glycerin solution?" Gordon asked. "Do I have to buy a special hydrometer as I did for the alcohol?"

"NOPE. Glycerine makes the water heavier so you can use your battery hydrometer. To make a solution that'll be safe down to zero, add enough glycerine to water to make the hydrometer float level with the eleven hundred mark," said Gus, indicating the mark on a hydrometer he picked up from the repair bench. "That'll be about a forty percent solution. A thirty percent solution will be safe down to about ten degrees, and the hydrometer reading for that proportion is one thousand and eighty."

"That sounds easy," Gordon commented. "Then if I want to test it at any time, all I've got to do is use the hydrometer."

"Right. But you want to make sure the solution is somewhere near room temperature," Gus reminded him. "Those readings only hold at sixty degrees."

"You win, Gus," Gordon finally agreed. "Fill her up with a solution of glycerin. I'll leave the car here for the rest of the day so you can clean out the cooling system and patch up any leaks you may find."

DEAD RACE HORSE "LIVES" AGAIN IN MARVEL OF TAXIDERMY

(Continued from page 19)

breakage. When the plaster was thoroughly dry, it was removed in sections, some weighing 270 pounds, to form the negative mold in which the permanent base would be built up.

The inside of each section of the mold was carefully coated with wax and strips of roofing paper, which had been soaked in paste, were pressed along the entire inside. Three other layers of paper followed, then two layers of burlap, soaked in a special composition plaster, and finally, an additional three layers of paper.

For a week, the paper and burlap remained in the mold to dry. At the end of that time, it was easily removed, forming a hard shell of unusual strength which reproduced every minute ridge and depression of the original clay model. In the meantime, the clay model had been taken down and the skeleton prepared for shipment to Australia, where it will be placed on permanent exhibition.

The sections of the hardened paper and burlap were then joined together by means of nails hammered into wooden supports that form part of the wood-and-steel framework which braces the interior of the shell. Coatings of shellac were painted on the exterior, sawdust was sprayed on, and other coats of shellac applied. The main base was complete. Only the fine touches remained to be put on.

One of these fine touches was reproducing the veins, especially in the legs. To do this, pieces of rope were immersed in paste and then glued to the form in the exact positions where the veins of the original animal had been. Close-up photographs of Phar Lap's "million dollar legs," as well as extensive anatomical charts, aided in this phase of the work.

When it was finished, the final step began. This was placing the skin on the completed mounting. An important new discovery, made by the Jonas brothers, was employed at this stage to increase the remarkable fidelity of their reproduction.

It is a special flexible plaster. It contains nine secret ingredients and was spread over the entire completed mounting under the skin. As it retains its flexibility and elasticity for some time, the new plaster permits the taxidermist to sculpture over the hide after it has been attached. By skillful pressure of the fingers and by pushing and pulling the hair this way and that, he can produce lifelike lines and ripples.

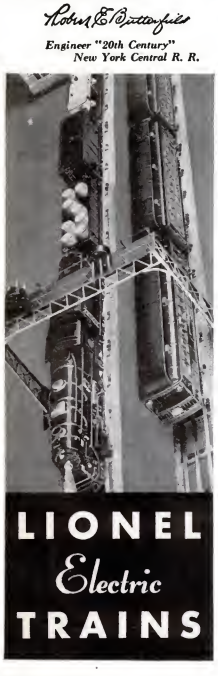
Besides attaching the skin to the form, the new plaster also protects it from future attacks by insects or other parasites.

Putting on the ears and tail, and making a few minor touches here and there, completed the work, an achievement that is receiving recognition as one of the outstanding feats of modern taxidermy.

Read what a famous railroader says:—I teach my grandsons railroading with Lionel equipment. They learn the principles of railroad operation — the switching and movement of trains. They learn something of mechanics, something of electricity, and they have a world of fun besides. Lionel trains are the only trains I would select."

Robert E. Butterfield

Engineer "20th Century"
New York Central R. R.



How to make your son THE HAPPIEST OF BOYS

IT is not the amount of money you spend on your boy's Christmas gift that counts—it is the amount of thought you put into the proper selection of your gift. The secret of giving your boy *lasting happiness* can be summed up in one word—*helpfulness*.

Help your boy by giving him a gift that will not only bring him fascinating fun, but, at the same time, help him become keen-witted, quick-thinking, resourceful. You can do both these things if you give him a Lionel Electric Train. For Lionel Trains are more than toys. They teach boys how to develop skill with their hands and skill with their brains —and, above all, they help boys form the habit of thinking problems out for themselves because they make these problems a fascinating game.

For instance, your boy will not only have the fun of building his railroad and operating it; he will have the opportunity to tackle actual problems of railroad operation that give him training in both electricity and mechanics.

Help him learn as he plays

Give him this help. *You can now buy your boy these sturdy trains for as little as $5.95*—and they last for years and years. Clip the coupon below. Take it to a Lionel dealer. He will give you, **FREE**, *the new 52-page Lionel Model Railroad Planning Book* that shows (1) how to plan and build a model railroad system and (2) what to get to make it true-to-life to the last detail. *Note:* If it is not easy for you to go to a Lionel dealer's store—mail the coupon to us and we will send you this expensive book if you send **10c** to cover handling and mailing costs.

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*NAME*_____

*STREET*_____

*CITY*_____ *STATE*_____

Amazing Facts of Today's Triumphs of Surgery

(Continued from page 17)

his hack. No avail. The meat had lodged in the voice box, plugging the passage to the lungs like a cork in a bottle. The choking man's face turned blue, then black.

There was only one thing to do. The surgeon tore off his dinner coat, stretched the sufferer on the floor and called for a pair of scissors. Using this crude operating instrument, he rapidly cut through the skin of the throat in a straight up-and-down line below the Adam's apple, spread the neck muscles apart, and made an opening in the tough windpipe below.

The surgeon held this opening apart with his fingers. The air rushed into the lungs of the sufferer. In a few minutes he was able to breathe easily again and his normal color returned. His life had been saved by a margin of less than a minute.

A piece of rubber tubing was then slipped into the opening in the windpipe to provide a direct route for oxygen to the lungs and the patient was taken to the hospital. Here, with time and facilities available, the piece of meat was removed by means of special instruments passed down the throat.

IN EXTREME cases of diphtheria, similar emergency operations are sometimes necessary. Usually, when the accumulating membrane threatens to stop up the air passage, the doctor passes a metal tube into the voice box to prevent suffocation. But when this special apparatus is not at hand, he must cut into the windpipe.

An operation of this kind, which employed probably the crudest equipment on record, saved a sailor from choking to death at sea. The opening below the Adam's apple was made with an ordinary jack-knife and into it was thrust a pipestem!

Nowadays, ocean liners carry complete operating rooms and the latest medical equipment. Some of the most thrilling feats of modern surgery take place on the high seas. Injuries resulting from accidents, and acute appendicitis, are the most frequent causes of operations on shipboard. To keep the rolling of the vessel from interfering with the work, the operating table and all of the equipment are secured to the floor. For a liner surgeon must perform delicate life-and-death operations even during storms.

I remember one dramatic instance of the sort. A transatlantic liner, bound for New York, was battering its way through a howling gale that lasted four days. Crashing against the side of the vessel, a green mountain of water hurled one of the seamen half across the deck. His head struck the iron house and the whole front of his skull was caved in with the impact. Only a delicate brain operation, removing the shattered fragments of bone, could save his life.

Quickly he was carried below. The operating room became a beehive of activity. The big ship swung head-on to the gale with its Diesel engines idling. Then, while the wind screeched through the rigging and white water burst continually over the bow of the plunging boat, the surgeon

Enemies Out of the Air

UNLESS your nerves are strong, don't read a history of conditions in the hospitals of 200 years ago. It is now hard to understand that they were simply houses of death. The mortality rate, following anything approaching a major operation, was simply appalling. What has changed them? Why is it patients today are seldom the victims of unseen, death-dealing enemies no matter how serious their operations? Next month, Dr. Damrau will answer these, and dozens of other questions, in an article packed with facts more thrilling than any romantic novel ever written.

bent over the still figure on the white table and performed a brain operation that was a success!

During a professional baseball game, several years ago, a pitched ball struck a batsman just above the left temple. He dropped to the ground as if shot. In a few moments he got up and amid loud cheering walked to first base. But when he tried to go to second, he fell in his tracks, unconscious.

At the hospital, it was decided that an artery inside the skull had been ruptured by the blow. Now the skull is a closed box. When bleeding takes place inside it, the blood must squeeze something and that something is the brain. Hence, the surgeon must open the skull and tie off the bleeding artery, or death is inevitable.

The patient's scalp was shaved and painted with iodine. Then the surgeon cut down to the bone. By means of a special drill, called a burr, he made several small openings in the skull bone. Through these, he passed a fine wire saw with two handles, cutting out a flap of bone which he turned back. Rough splinters he carefully clipped away with pincers specially designed for the purpose.

Sponging away the blood from the membrane covering the brain, he peered inside. There it was, a jet of blood spurting with each beat of the heart! Quickly he passed a loop of catgut around the spurting artery and pulled it taut.

In a moment all bleeding had stopped and the danger was over. The flap of bone was turned back, the scalp wound sewed up, and the operation was over—an operation without which the athlete would certainly have died.

ON SOME western railroads, operating rooms on wheels have been made part of the equipment of wrecking trains. These special cars enable surgeons to perform emergency operations at the scene of a disaster, saving lives that might be lost if the operation had to be delayed until a distant hospital was reached.

In disasters of all kinds the skill of the surgeon plays an important part. Often, working with unsatisfactory equipment at the scene of an accident, he has to battle against tremendous odds.

Such was the case, a few weeks ago, in West Virginia. Far below the surface of the earth, the slate roof of a coal mine corridor collapsed. The falling rock caught one of the miners, pinning him by the arms. His companions worked frantically to free him. An automobile jack, sent down from above, was used to pry up the slate so one arm was released. But the rescuers saw that any attempt to free the other arm would bring the whole mass of rock toppling over on the trapped man.

A surgeon responded to a hurry-up call. Entering the cage with his instruments, he was lowered hundreds of feet into the pitch-black mine. Crouched, he inched his way along the dangerous corridor where the cave-in had occurred until he reached the scene of the accident. While the other members of the rescue party held aloft their little lamps to illuminate as much as he could, he administered the anesthetic and then, lying flat on his back in the cramped quarters, performed the amputation that freed the injured miner.

Special care is taken in every well-equipped operating room to provide perfect illumination for the surgeon. Directly above the table a great dome reflects the light downward in such a manner that his hands and instruments cast no shadows. If the electric current should go off during an operation, auxiliary batteries and generators in modern hospitals stand ready to take up the burden of supplying light to the operating room without an instant's delay. Preparing for the unexpected is an important phase of the work of every surgical staff.

There are many thousands of ailments that human flesh is heir to. Only a few, of course, require emergency operations. But when they do occur, life and death often hang in the balance and the skill of modern surgery is taxed to its utmost to perform some of its most amazing miracles.

Airport on Stilts for Heart of London

BUILDINGS to be raised in the English capital are designed to support a gigantic wheel-shaped landing field for planes. The radiating runways would be a mile long. A model of the field, seen in this picture, proves it would provide accommodation for a great many machines.

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